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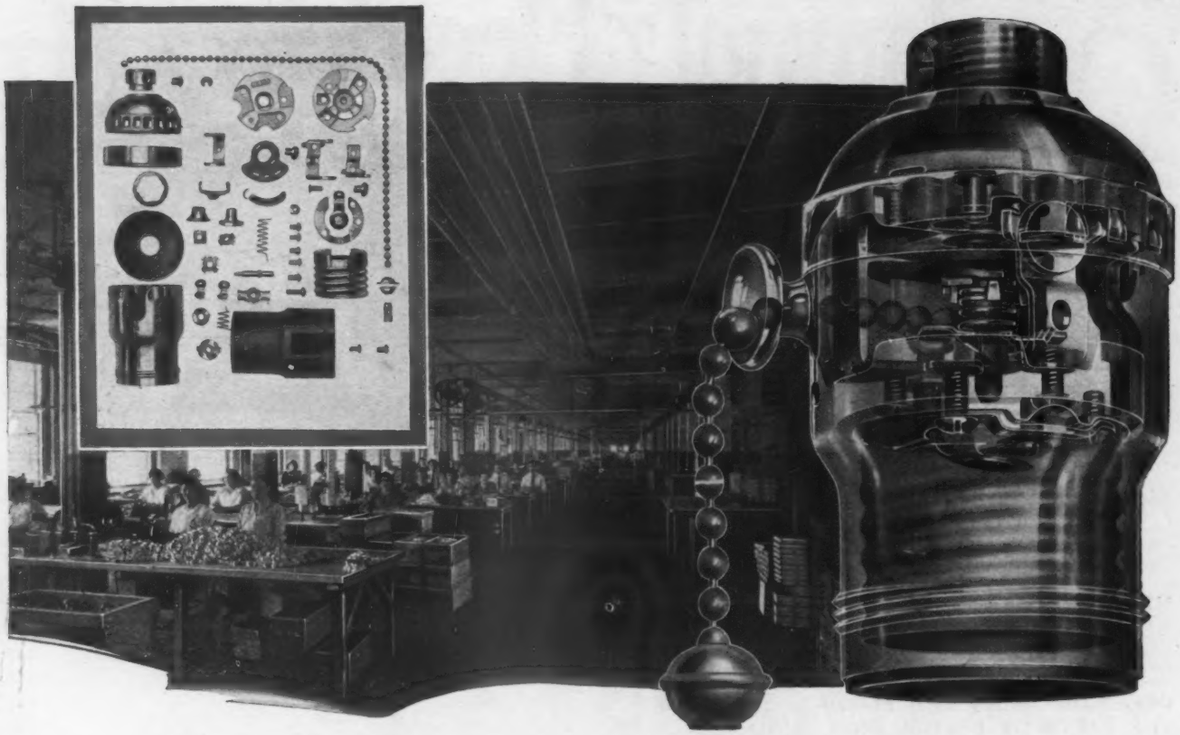

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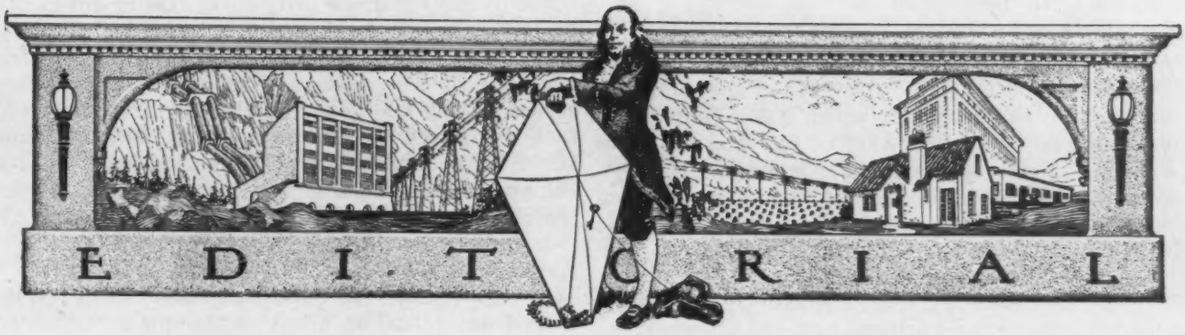


Recording a Year of Electrical Progress

PAPERS to be presented before the annual convention of the Pacific Coast Electrical Association at the Fairmont Hotel, San Francisco, June 19 to 22, occupy the major portion of the greatly enlarged editorial section of this issue.

THE discussions cover a wide range of subjects, and present an accurate cross-section of the most advanced thinking in the development of the generation and application of electrical energy to the service of mankind. Accounting, commercial, technical and public relations, broadly represent the elements covered so forcefully and clearly by the many committees of specialists who have given so generously of their time and experience that all may benefit thereby.

WHILE, fundamentally, the discussions center about the central stations as the foundation upon which the electrical industry of the West is erected, the information given is no less valuable to every link in the chain of electrical service, to every man engaged in the application of electricity for any purpose. To the man who is not content to skim over the surface in a superficial way, but who has the desire to dig down to the very root of things electrical, the opportunity of benefiting through the service rendered by the Pacific Coast Electrical Association cannot be overestimated.

MUCH of the advanced thinking in the electrical field has originated in the Western States. In many particulars, the region west of the Rockies is better developed electrically than any other section of the United States. Thus, the papers and discussions appearing in this issue, representing as they do the critical analyses of men who have placed the West on the electrical map, have an interest and importance that transcends a mere locality, great though it is. They are of national, even international interest, and, as such, richly merit the careful study of our readers. The quality of the papers "reflects the painstaking research, careful weighing, analytical penetration and discriminating contacts of fine minds exceptionally equipped by native capacity and practical experience to formulate and express opinions that thinking men find worth reading."

THE publication of these papers in the Journal of Electricity and Western Industry prior to the dates of the convention at once affords an opportunity to all members of the Association to study the subject matter offered that they may be prepared to participate in the discussions; it bring the convention to those who are so unfortunate as to be unable to attend, and it brings to all readers of this paper the privilege of participating to this extent in the benefits of membership.

IN this editorial, we have used the term "thinking men." It is to them that the world in which we live owes its material and moral progress, and it is to them that this issue is dedicated.

Supreme Court Decision of Great Importance to Power Progress

A decision of great importance to electric power development in the West is that of the Supreme Court of the United States which has recently dismissed the petition of the City of Los Angeles for a rehearing of the city's case for condemning property on the Owens River in California. The decision denied the right of the City of Los Angeles to condemn certain lands for municipal purposes on the Owens River, owned by the Southern Sierras Power Company and used by that company in supplying power to cities in the southern part of California.

The Supreme Court decision ends a controversy which has been in progress since February 1920. The first decision handed down by the United States District Court, granted the city a right to condemn the property. The power company appealed to the United States Circuit Court and on Nov. 5, 1922, that body decided that no showing had been made that the public use of a municipal corporation was more necessary than that of a utility, privately owned, and serving other cities, reversing the decision of the lower court. The appeal to the Supreme Court was made by the city and the dismissal made by that body ends the legal battle.

Throughout the series of suits, several cities have linked with the power company in its fight against Los Angeles. Riverside and San Bernardino, two of the cities served by the power company, had legal representatives working with the legal department of the company in fighting the suits.

The decision affects power development all over the West, for, if the decision had been in favor of the City of Los Angeles, it would have been possible for a municipal corporation not only to acquire by condemnation proceedings, property within its limits, cerned but also service rendered by that public utilit operated. Thus municipal corporations could obtain property of privately owned companies at will and thereby not only cripple the public utility concerned but also service rendered by that public utility to other communities and municipal corporations other than the one seeking to condemn.

"Make Toast Your Breakfast Food" Campaign of Bakers' Association

THE American Bakers' Association is now engaged in launching before the baking industry and the consuming public a national toast campaign. The campaign has as its object the placing of an electric toaster on the breakfast table of every wired home in order that the baker can sell more bread to be made into toast. The possibilities opened to electrical dealers, power companies and toaster manufacturers is readily apparent, since an increase in demand for toasters will result from the efforts of this movement.

Twelve toaster manufacturers have already cooperated with the Bakers' Association who "found thirty different toasters on the market, all designed by electrical engineers who had never seen a slice of bread, apparently." Many of the toasters were criticized by the American Institute of Baking for faulty design from the bakers' and consumers' point of view. As a result of a conference between research engineers of the bakers and the electrical manufacturers, baking knowledge was brought into close contact with electrical knowledge and there are now seven types of toasters on the market that "deliver the goods" as compared with three before this research was undertaken.

"Baking Technology," the journal of the Bakers' Association, comments on these tests as follows:

"The quality of toast the different toasters turned out varied as much as the quality of bread one might buy in a large city. One supplied such intense heat that the bread burned before it toasted.

"Another left a blank strip a fourth of an inch wide along the bottom of the slice of bread. Only a very few of the toasters would take the bakers' standard loaf of 24 ounce size. Some made good toast along the bottom but burned a strip along the top. One toasted the bread evenly, but did it so slowly that it dried out before it toasted.

"And then there was the best one on the market. It toasted the bread evenly, brought it up with a fine color. It took the pound and a half loaf slices, and had a device for turning the toast that always worked well except for very thick slices. With these facts determined, it was ascertained just why each toaster fell away from the ideal. Suggestions were made to the manufacturers. Most were acted upon."

An advertising campaign is being worked up in which manufacturers of electric current, of electric toasters, "of butter which is never spread so thick, to such good advantage as upon toast, and of bread, will all combine to popularize toast for breakfast" and to push the sale of splendidly designed low-cost toasters on which to make this toast in the most convenient way.

Electric Development of Europe Proceeding at Rapid Rate

THE scarcity and high price of coal in all the countries of the world have led to a rapid increase in the use of water power. In the United States this increase is shown by the greater activity in the development of the great potential powers of the Colorado, Columbia, and St. Lawrence rivers. Progress in actual construction is shown by the horsepower of the projects for which licenses have been issued by the Federal Power Commission. The proposed turbine capacity of projects under construction for which licenses were issued in 1921 and 1922 was 1,500,000 horsepower. This capacity includes only that of projects on public lands and public reservations or navigable streams.

In Europe the high cost and scarcity of coal, especially in countries importing it, have been an even greater incentive to the utilization of potential water power. Hydroelectric power is used mostly in the cities for lighting and for industrial use, but two tendencies of development in Europe that are evident to a less extent in this country, are the extension of electrical transmission lines to serve the

farming districts and the electrification of the railroads.

In the United States the electrification of the rural districts, according to reports received by the Geological Survey, is proceeding normally through the extension of transmission lines from cities and towns to surrounding areas. In the West settlers on some irrigation projects are supplied with power from plants operated in connection with the irrigation works.

Although the United States exceeds every other country in the mileage of steam railways that have been electrified (1,600 miles), the electrification of railroads is now proceeding more rapidly in Europe than in this country.

Failure of Colorado Compact Halts River Development Plans

PENDING a settlement of the deadlock resulting from the failure of all of the states involved to ratify the Colorado River Compact, the Federal Power Commission has decided to defer for the present consideration of all applications affecting the Colorado River. Prominent among these applications are those of the Utah Power & Light Company for a project on the Green River at Flaming Gorge in northern Utah and the Girand project on Diamond Creek in Arizona.

Arizona is the only state which has not ratified the compact. The House and the Senate of its legislature both sought to annex reservations but could not agree on what the reservations were to be, and the legislature adjourned without further action. One of the reservations desired by the Senate was to the effect that there should be paid into the Treasury of the State of Arizona a tax of $5 per annum for every horsepower of electrical energy developed. The legislature of Arizona will not meet again until November, 1924. At the present time the Colorado River question is the most prominent public issue in Arizona. Sentiment is divided between those favoring Arizona's ratification of the compact as it stands and another group favoring state development of the river.

There are many difficulties standing in the way of the latter procedure. One is the fact that a provision of the constitution would prevent the state laying claim to title to public lands or Indian reservations. The Glen Canyon site, which would be the most likely to be suggested for development under such a plan, includes public domain and Indian reservation lands. In addition the actual dam site has been reserved as a power site under the jurisdiction of the Federal Power Commission.

If the Federal Power Commission continues its announced policy of granting no licenses until a settlement of the pact controversy by ratification, Arizona will no doubt ratify the pact. It would appear that a ratification of the pact will not be detrimental to Arizona. It will undoubtedly be the most important step yet taken in the development of the Southwest and will avoid a generation or more of litigation by defining at the present time the rights upon which public and private capital may be invested, and will lift the embargo now retarding the development of the entire Colorado River Basin.

Definite Criteria Upon Which to Base the Extension of Credit

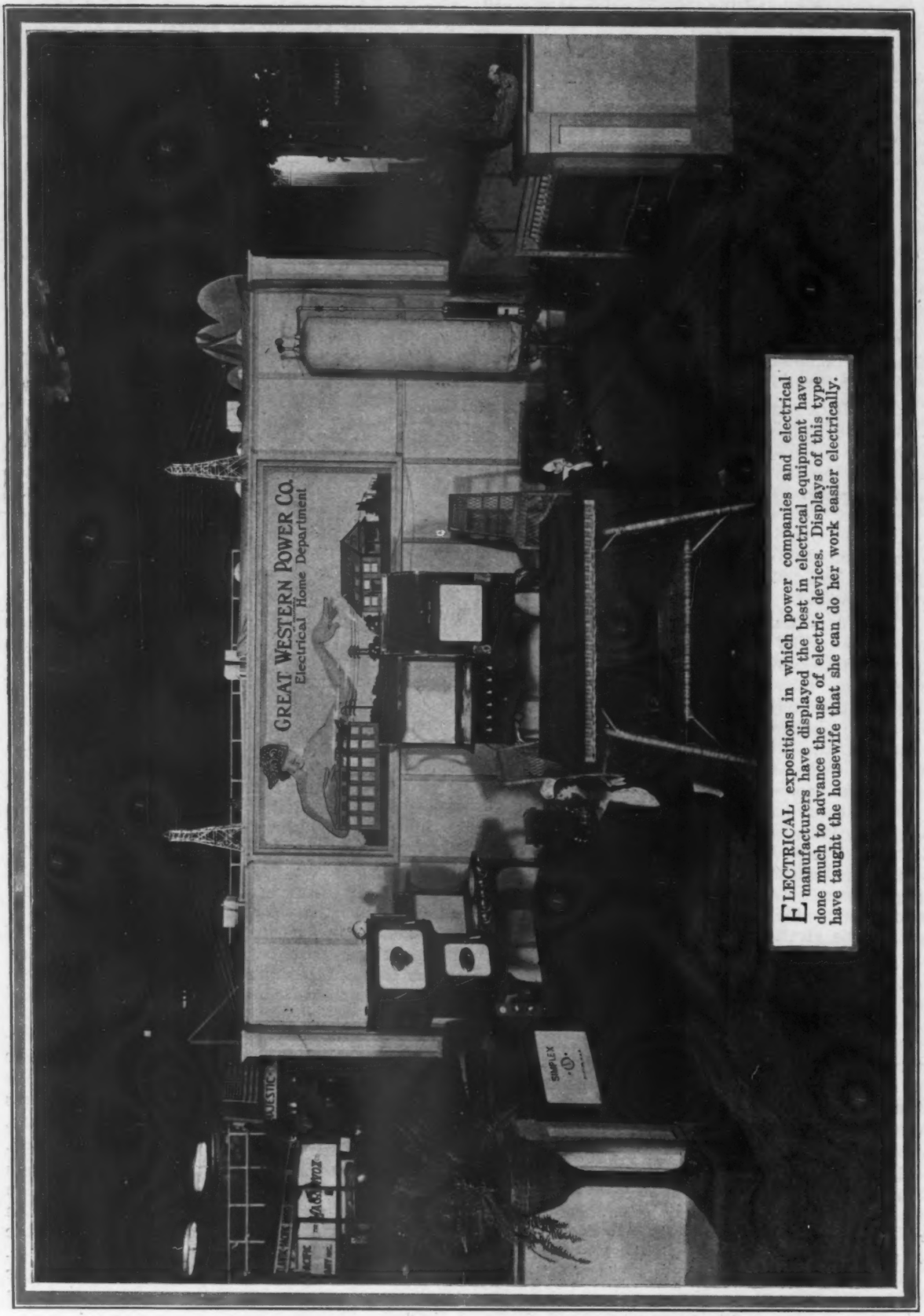
CREDIT discussion is not confined to the electrical industry alone. Dun, Bradstreet or Babson statistics sound an annual warning of the wrecks that lie in the path of business due to ill-judged granting of credit. In fact, over-extension of credits shares with ill-advised buying responsibility for the great majority of business failures.

The position of the credit man with any large organization is no sinecure, especially if the credit man realizes not only that he is responsible for the financial success of the enterprise, but also that a constant repetition of "no," will result in no business at all.

The greatest menace to the peace of mind of the credit man is the over-zealous salesman, the type that would give to the customer a deed to Golden Gate Park in consideration of an order for one-twelfth of a dozen assorted curling irons sold at six months net. The problem confronting the management is to strike a sane, intelligent balance between the enthusiasm of the salesman, and the negative reactions of the credit man.

Over-credits do the recipient a positive injury, and hurt the industry as a whole. For this state of affairs competition between business rivals is largely responsible, but nevertheless, this has gone on for years, and, to an extent, will probably continue. It would seem that the best solution of the credit problem would be the determination of a definite set of criteria upon which the amount of credit should be based, and then subject all applications for credit to this measuring stick, and abide by the result consistently. There is, of course, a human element that figures in appraising a man as a credit risk, his moral character, his standing in the community, his reputation for meeting obligations, and his knowledge of his business, and frequently much credit is granted upon nothing more tangible than these considerations. On the other hand, it would seem that something more substantial than personal honesty and good intentions should be back of the credit customer. The relation between many of our larger jobbing houses and their retail outlets may even become more like those of a banker than a merchant, which requires a large floating reservoir of capital that acts as a lump of undigested food in the stomach of trade, out in that twilight zone between sale and collection.

We believe that there is an abundance of brain and initiative within the electrical industry that can develop a clear-cut, intelligent credit policy through the establishment of a set of criteria by which the amount of credit, if any, that any man is entitled to, may be determined. We would like to learn of the experience of any who have attempted to devise such a method.



ELECTRICAL expositions in which power companies and electrical manufacturers have displayed the best in electrical equipment have done much to advance the use of electric devices. Displays of this type have taught the housewife that she can do her work easier electrically.

Merchandising Electric Ranges

By A. H. Nicoll and Herbert Cram

THE public can only be sold the idea of electric cookery when the electrical people can intelligently propound the idea, and no salesman or executive can speak intelligently on the idea until he possesses an electric range in his own home. Indifference such as this is standing in the way of greater range sales.

So much has been written about the cooking and heating end of the electrical business that the committee handling the paper this year despaired of finding any feature of the subject that has not been brought out in a most convincing manner—especially is this true of last year's paper, which is a matter of record. It went into the question of rates, revenue, increased business and power company experiences in handling cooking and heating and became convinced of the desirability of this load from the central station standpoint.

It is well recognized that the central station at this time is one of the most important factors in the sale and promotion of electric ranges and what speaks volumes for its future on the Pacific Coast is the fact that in the past year several of the largest companies have redoubled their former efforts and were able to turn in a very gratifying record of sales. In addition to this, two of the largest power companies on the coast and several smaller ones have just entered the field and are going out actively after this business.

It is not the intention of this paper to repeat the history of cooking or follow it through its various stages of wood, fuel oil, coal, natural and artificial gas. We are addressing electrical folks and assume that as such we admit the "arrival" of electric cooking and heating and are preparing ourselves to help in the education of the public along this line.

A quarter of a million people visited electric homes in the West during the year of 1922. It is proposed to tell the electric home story to twice that number in 1923.

In a series of cooking schools conducted for the benefit of the general public in the Pacific Northwest during the latfor part of 1922 the electric cooking message was brought directly to the attention of over ten thousand housewives and indirectly to two hundred thousand homes. The task now consists of following up this large number of live prospects in that territory.

Shall we take "pot shots" or shall we do a little private practice on the home "range" and bring 'em down with straight shooting based on first-hand knowledge? Let us first sell the idea to ourselves. Then our own enthusiasm for promoting sales will increase without measure and the public will place full reliance in the sales arguments used to dispose of our goods. Many plans have been worked on the past year to promote the electric idea to the public. Perhaps nothing compares with the "electric home" and no other form of advertising compares in results with those accruing from the staging of exhibitions of this kind. One eastern journal made an effort to keep track of the number of electric homes built in 1922 and when they reached the 120 mark they could not move fast enough and frankly admit they lost the count.

Twelve electric homes have been built and exhibited in the West in the past year. One hundred and sixteen thousand people visited the seven homes located in Seattle, Oakland, Alhambra and Vancouver, B. C.

That the public is interested in electrical comforts and conveniences has been evidenced by increased purchases of domestic appliances in every city in which a home has been displayed.

Another plan to carry the cooking and heating message into the cross-road and mountain districts, as well as into the larger towns and cities was brought to a successful conclusion by one of our large central station companies during the past season, as is shown by the following information, based on their experiences during the year 1922:

"During this period we held a total of 58 demonstrations, for which 24,000 invitations were sent out. Attendance was approximately 8,000 or 33 per cent. The various ranges listed in our price book were used for actual demonstration, only one range being used each time.

"During our demonstration variable programs of interest were presented, including, among other things, a wireless concert, moving pictures and other minor forms of entertainment.

"A prize was given at each demonstration, consisting of a toaster or some other lamp socket appliance, and the range used was offered for sale, subject to immediate purchase, at a reduction of $25 from the regular price. This special price offer on the range resulted in a high percentage of acceptances.

"Demonstrations consisted of a dissertation on electric cooking, actual cooking and serving of samples to those present. This general method of demonstration was found so satisfactory that it is our intention to repeat the procedure this year. Sales of ranges and water heaters increased noticeably after the work got well under way, and we feel justified in an expenditure this year as great as that of 1922.

"In addition to these demonstrations, 11 displays of model electrical kitchens were conducted at county fairs and a three weeks' active demonstration was carried on at the Industrial Exposition in San Francisco."

Another power company tried the plan of using factory demonstrators in their various company offices. These were cooking demonstrations and would generally last a week in the smaller cities and two weeks in the larger ones. After a reasonable period this was repeated with another make of range. The benefits were not only in the sale of ranges, but in the opportunity it gave their employees to see the equipment under actual working conditions.

1922 Shows New Development

In past years large installations of ranges in apartment houses were not uncommon, but only in the last year has the 100 per cent electric installation obtained a real hearing. Of all the possible purchasers of electric equipment, the landlord is perhaps the most difficult prospect to handle, and he is skeptical not only of his own expense in the matter, but also of the attitude of his tenants. He must be convinced that they will regard electric ranges and electric heaters as an advantage and not as a drawback before he will be willing to place them in his house or apartments.

Among the many electrically equipped apartments now finished and under construction perhaps the most interesting is one now being built in San Francisco. This building consists of fifteen apartments and will be completely equipped for electric cooking, air and water heating. The heating system will be unique in that it will be the first large electric installation in which the heaters are controlled from a central point. Each room in the building will be provided with a flush type electric heater of sufficient capacity to take care of a difference in temperature of 30 deg. between the inside and outside of the building. Each heater will be provided with a three-wire circuit to the central point, and each heater will be built so that 100 per cent, 60 per cent or 25 per cent of capacity can be operated from the central point of control. This arrangement makes it possible for the janitor to control the maximum demand, and with the exception of extremely cold periods, it is estimated that 60 per cent of load will be the maximum capacity required. In addition to the central control, the heater will be controlled with an "on and off" three-pole switch, conveniently located near the heater. The owner proposes to provide the heat, but the wiring is so arranged that, at any time, any apartment may arrange for connecting its heaters to the range meter, in which case the owner will make allowance in the rent.

The water system will consist of a 450-gal. central tank with three 5,000-watt automatic electric heaters, providing continuous hot water service.

The current will be purchased by the owner through master meters and sub-metered to each tenant for lighting and cooking.

Another installation which is typical of the present tendency towards appreciating the advantages of electrical cooking and heating is a new San Francisco apartment house, consisting of 33 apartments, renting at $60 to $75—completely equipped—and depending entirely on electricity for cooking, heating and water heating. Each tenant has his own cooking and heating meter and the owner provides continuous hot water service by means of a battery of 6-kw. automatic electric water heaters connected to a 1,000-gal. boiler.

Another apartment house depending entirely on electricity for cooking, heating and water heating allows each tenant the cost of 130 kw-hr. off his rent, the tenant paying any excess. In this case each tenant has his own water heater. Installations such as these will be watched with a great deal of interest and will go a long way in convincing the future electrical landlords.

Another very interesting installation is the electric heating of a theater in the San Joaquin Valley. This is arranged in connection with a cooling system for use in summer, whereby the air is drawn through a spray of water and forced under the floor of the building, where it enters the theater proper, through the ventilators under the seats. There is then an escape for the air through the ceiling of the building. An electric heater has been constructed which, during the winter months, is attached to the same ventilating fan so that air, instead of being drawn through the spray of water for cooling, is drawn through the heater and then forced under the floor of the building, entering the house through the ventilators, thus reversing the effect of the cool air in summer. This heater is 95-kw. capacity, three-phase, 220 volts, and is arranged with regulating switches so that it can be operated at full, two-thirds or one-third heat, the load being pulled off of three phases simultaneously, so that it is always balanced. This heater has a capacity sufficient to overcome a temperature difference of 35 deg. between the inside and outside of the theatre, with a movement of 7,000 cu. ft. per min., thus changing the air in the theater three times per hour. No definite figures have yet been obtained as to operating cost, for the reason that it will be necessary to wait until next winter in order to secure minimum temperatures. The furnace is so constructed that it can be readily moved up and attached to the fan, or it can be disconnected and moved into another room for storage during the summer months.

Domestic Science Classes

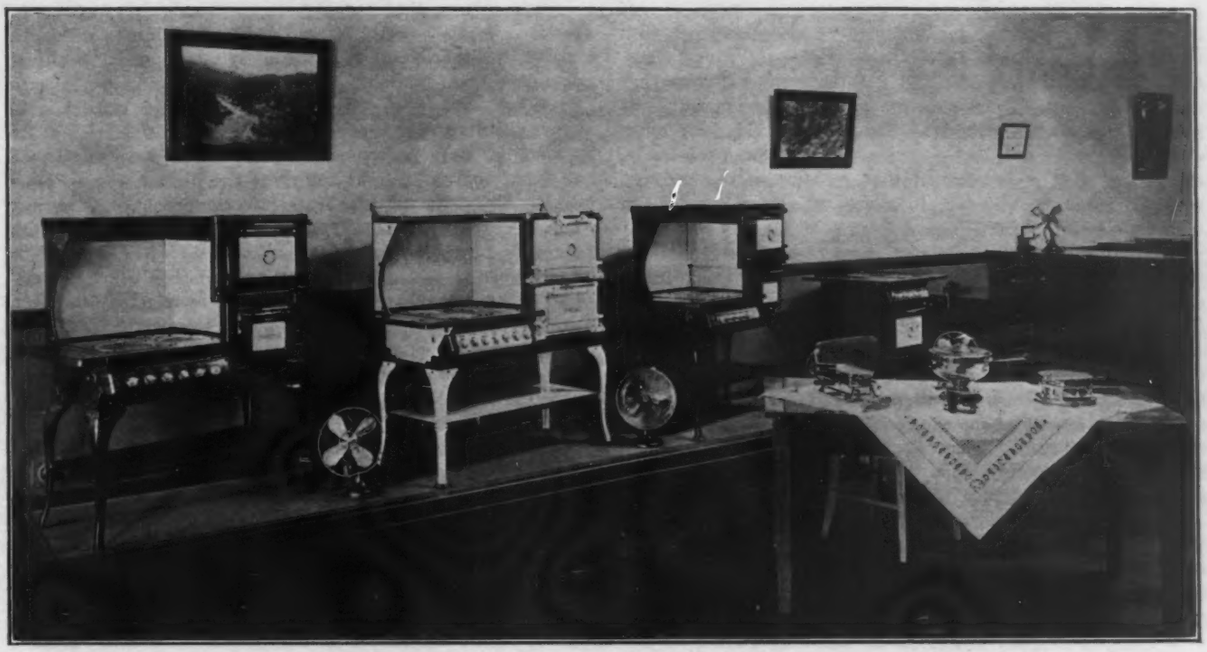
The large number of beautiful new schools on the Pacific Coast offer a tremendous educational field for electric cooking. A small number of these schools are equipped with electric cooking apparatus, but the field as a whole is surprisingly undeveloped.

The domestic science class teaches the use of the latest and best apparatus, and for that reason should be equipped with electric ovens and ranges.

Large benefits would result from the daily publicity given electric cooking by the pupils, who will talk and "sell" the electric idea every day. The period of transition from school girl to housewife is shorter today than ever before, and this means that the habits developed in the domestic science classrooms will be the habits which will, in most instances, be practised in their own homes. There are thousands of young women enrolled in these classes. The city of Oakland alone, with its 22 elementary, 10 junior high and 6 high schools has an enrollment of 2,839. This is a fair-sized group of possible boosters and future buyers and it represents only one city.

Then there is the sale of the equipment.

The building program in California alone is tremendous. San Francisco, Oakland and Sacramento have voted for over 25 millions. There are 20 new high schools in course of construction or contemplated in California, outside of the large cities, all providing for cooking classes. How many of these will be electric? The first real organized effort to attract this business was when the California Electrical Cooperative Campaign determined that in Los Angeles, where an extensive school building program is under way, it would exert every effort toward the electrification of the domestic science de-



This picture of the show room of one of the branch offices of the Southern California Edison Company was taken several years ago. This company has been marketing electric ranges for some time and has found that it is a good means of advancing the number of ranges installed.

partments of these new schools. To do this, it was first necessary, of course, to thoroughly convince the Board of Education of the advisability of such a step by pointing out to them conclusively the practical advantages of electrical cooking and give assurances of a general utilization in the future.

This was accomplished through a dinner meeting to which the Los Angeles Board of Education and the entire staff of the domestic science department were invited as guests of the electrical industry. This dinner, which was attended by approximately 300, of whom over half were of the school department and the balance of the electrical industry, was cooked entirely by electricity. The dinner was followed by several short talks upon the advantages of electrical cooking and the important part which electricity will play in homes in the future, and a response by the school superintendent expressing appreciation of the valuable information received. The dinner was successful not only in that it created a most favorable impression upon over a hundred and fifty teachers, who have in hand the molding of the ideas of future housewives, but it secured in the newspapers an impressive quantity of valuable publicity.

But however much we have been benefited in the past from all this business, and however much we appreciate this valuable publicity, we must always bear in mind that if this electrical industry of ours is to grow, the electrical dealer will and must function in so far as he is able.

There are several fundamental reasons, however, which still preclude the dealer at large from doing the big job of selling ranges—the most important of which we think is the financial side. It takes considerable time and money to create and promote range business and at at present, we repeat, the central station is the logical one to put this idea over, with the thought that eventually it will revert to the electrical dealer when the public generally has accepted the idea of electric cooking.

When will the public accept the idea of electric cooking?

This big question is, we believe, the heart of this paper. The public will only be sold this idea in direct proportion to the way we as electrical people can intelligently propound the idea, and we can never expect to attain this ambition with the half-hearted hit-and-miss system we are employing now.

Every central station executive and salesman who has any connection with electric sales departments must have an electric range in his own home.

This is of vital importance and while this same thought has been brought to our attention many times, we have only accepted it as theory and as far as can be observed very little attention has been paid to it.

Our industry is made up of many men in executive capacities who should and could purchase and install an electric range (if they believe in it). But by their example of indifference they have sown this same seed to their subordinates with the result we have today, a big electrical industry with men in many various ways making their livelihood from the electric business, playing "possum" by not practising what they preach.

Most manufacturers of electric ranges have seen the seriousness of this and have offered to central station and dealers' employees their ranges below cost. But why should manufacturers or jobbers have to go this far and pay you money to buy a device which presumably you recognize as being the only way that you, as an electrical man, should cook?

Some central stations have claimed that prices of ranges are too high. If they are—and we're not saying they are—have you considered the why of it? If a manufacturer or a jobber gives you a range at a price below established markets, it increases his cost. If a manufacturer or a jobber has to not only sell the central station but every "Doubting Thomas" in the organization and then go out and sell the consumer too, doesn't it run up a selling expense above normal?

One prominent manufacturer has stated that electric ranges are underpriced about 10 per cent, meaning that a consumer is getting a piece of merchandise of a value higher by 10 per cent than she is paying for. Co-ordinated manufacturing, distributing and selling, and buying will, we be-

lieve, be the stepping-stones to a better understanding of comparative prices, but for the present we must deal with the subject as we have—i.e., sell the service the range gives, the quality of the cooking and not the iron and steel that makes the range. By comparison with washing machines at $150 to $175, phonographs from $50 to $500, sewing machines up to $175, etc., our electric ranges compare most favorably, especially when it is recalled that cooking in the average home consumes more hours in a day than washing does in a week.

Many thousands of dollars are spent by central stations in developing, organizing and training an electric range sales department, many conferences are held periodically throughout the year—bringing salesmen in from their territory to some division headquarters for the purpose of imparting more information to the men concerning electric ranges. This, we believe, costs the central station many dollars per man and still the job is only about one-fourth done because the salesman goes back to his home filled with ideas as to the theory of electric cooking only to have his wife cook his dinner with some other fuel.

We are probably attacking the problem from the wrong end. Why should we ask a salesman to discard some cooking device, in which he has invested his money, to propound our idea of electric cooking, when many of the executives are not themselves using this equipment?

Can you imagine an automobile salesman calling on you to sell a car, either riding a bicycle or in a horse and buggy—a clothing salesman waiting on you dressed in overalls? Why, then, should central station executives send a man out to call on your wife and mine to sell her an electric range when he is using any one of many other kinds of fuel? It simply cannot be done consistently and never will be done until we recognize this point. The automobile salesman does not have to buy an auto to demonstrate to his customers. Car agencies and factories have a certain number of cars at the disposal of their sales people to help them sell the idea of the pleasure in auto riding.

As a remedy for this serious ailment, we recommend the plan of having the central station purchase a range for each of their soliciting salesmen and install it in his home, charging the salesman $10 per month until the entire amount is paid to the central station, when the range would revert to the salesman. If the salesman should leave the employ of the company, the range would revert to the company to be used again for the next salesman. We believe this scheme will not, in the end, cost as much as frequent sales conferences, but will in a most decisive way educate our sales organizations in the use of this line of merchandise.

The plan if adopted by a central station should be agreed upon between salesman and employer when he enters your organization, so that right from the start he presents himself to your customers as a user of an electric range and consequently commands more serious attention from the prospect.

One central station man recently said, "We that use electric ranges in our homes should have a little button which would read, 'I use an Electric Range at home—Do You?'" We are afraid that our club would be small and venture to say that if a poll were taken of any conference, "electric range owners" would be in the minority.

Methods of Compensation for Salesmen

Practically every central station has different methods of compensation, some of which we list below:

1. Straight salary.
2. Salary and commission based on price of merchandise sold.
3. Salary and commission based on net increase of connected load.
4. Straight commission.

We believe that outside electrical salesmen, generally speaking, should be recompensed for their ability to sell more merchandise than another salesman in a comparable position, but with central stations we had a very different problem to face. The duty of any salesman for a central station is to sell satisfaction plus connected load. This satisfaction must be sold not only to consumers but dealers as well; hence our belief that a straight salary is the logical way to compensate except for the fact that extra compensation is always regarded and thought of in a much more appreciative way. Therefore, our belief is in a straight salary of an amount to attract good, clean, aggressive men, and then allow a very small commission based on increase of connected load less disconnects. This should be computed by districts and distributed to every employee in the district rather than to the salesmen only, thereby making sales people out of every one in the organization.

Straight commission work, or compensation based on sale of merchandise, has a very strong tendency to attract salesmen of exceptional ability for a short time only. This means much loss in educational expense due to labor turnover, also the possibilities of feeling between dealers and central station salesmen due entirely to natural selfishness on the part of salesmen to get the order and the commission. One other evil of this method is the possibility of the salesman splitting his commissions to land business, and many other special dealings which will not develop with salaried men.

In conclusion, our belief is that we must quickly recognize the necessity of equipping our sales organization electrically. If our solution is impractical, we should adopt a modification of it to suit local conditions, but by all means—we must adopt something.

Need For Better Illumination

By C. O. Martin*

TO fully appreciate the extent of the industrial lighting field we have only to note the results of recent surveys which show that approximately 60 per cent of the existing ing industrial plants of the country are in need of better lighting. In time of marked industrial activity this need becomes even greater because of the demand for increased production and the factory executive, where informed, is not only willing, but anxious, to spend money on illumination to help attain this greater and more efficient production.

Selling proper industrial illumination is a profitable business, not along to one class, but to all, and carries with it a created demand for a long list of electrical products and services. To the contractor-dealer it means greater profit on work and materials; to the central station, larger load and increased revenue; while, to the jobber and manufacturer, a stimulated sale of supplies and manufactured products. To the public at large, the effect of good industrial illumination is felt in the proportionate reduction in the cost of each unit of the finished product. This is brought about through the increased quantity and improved quality of that product as a result of the higher state of health, contentment, safety and skill of employees working under proper lighting conditions.

Like any other branch of the electrical industry, however, industrial illumination needs special study. It is not within the scope of this paper to go into the essential details for the design of adequate factory illumination, but to point out, in a general way, what constitutes adequate and satisfactory illumination as against the all too prevalent poor illumination, or just mere light, found in our factories. First

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of all, of course, there is the question of providing sufficient intensity on the working planes. Years of experience in factory lighting practice have established quite definitely the intensities best suited for the different classes of industry, as well as for the different operations within the industries themselves. These are expressed in foot-candles and are compiled in the form of tables available from any of the reflector and lamp manufacturers. Aside from sufficient intensity, there are other factors to be taken into account, chief among which are: elimination of glare, both direct and reflected, through the use of correctly designed reflectors, and the reduction of objectionable shadows through the careful choice and location of lighting units. Glare is fatiguing to the eye and may even produce permanent impairment of vision, while sharp, dark shadows not only slow up production, but also add greatly to the liability of accident.

Though there are three or more distinct types of reflectors used for industrial lighting, the most common and that accepted as the most satisfactory for all general purposes is the R. L. M. standard dome reflector. It is a porcelain enamelled steel reflector and is the result of the desire on the part of the reflector and lamp manufacturers, working jointly, to do away with the multiplicity of designs and to offer the industrial management a single standard for securing good illumination. The R. L. M. standard dome reflector, therefore, with a bowl enamelled Mazda C lamp, properly chosen as to size and correctly installed as to spacing and mounting height, will, in general, give all that might be desired for a first-class industrial lighting installation.

Quite naturally, the major consideration in the eyes of the factory or mill owner is the money value of good light in the larger return in both quantity and quality of work which may result from the installation of a superior, as compared with an inferior, lighting system. Though a little difficult, perhaps, of interpretation into dollars and cents, we can safely say, and without contradiction, that good lighting is one of the least expensive of the tools commonly used in a shop, being much less even than heating and usually less than the cost of workmans' insurance. For instance, allowing each workman 100 sq. ft. of working space and counting in maintenance, lamp renewals, operating expense of the system, interest on the investment and depreciation, the cost of good lighting will not exceed 1.2 per cent of his wages, which, when contrasted with an increase in production of from 8 per cent to 20 per cent, a decrease of spoilage of approximately 25 per cent, and a decrease in accidents, with a corresponding decrease in insurance rates, leaves no doubt as to the big savings possible through a small cost for good lighting.

It has been found in interviewing factory executives that far more than half of them are entirely uninformed about lighting and its importance to a properly conducted plant. This applies not only to existing plants, but also to new ones being constructed every day. Upon whom, then, does the responsibility fall of enlightening these executives on their needs? Who are these men in the "first line of attack"? Primarily, they are the electrical contractors and the men in the commercial departments of the light and power companies. Then follow the dealer, the jobber and the manufacturer. The electrical contractor who, in the conduct of his business, comes in closer contact, perhaps, than anyone else with the man who foots the bill, has the real opportunity and, if measuring up to his responsibilities, will sell the idea of proper lighting and add just that much more profit for himself through more work and the use of increased quantities of materials, to say nothing of securing the good-will and satisfaction of his client.

Electric Signs and Billboard Illumination

By Paul D. Howse and Tracy W. Simpson*

THE commercial utility of the electric sign has become distinctly recognized, and it is now taking its place with store fixtures in the appropriation of business men starting new institutions. The desire has been created and the advertising value recognized, hence the electrical sign manufacturers, central stations and manufacturers of materials are receiving increased benefits. The electrical population of the West increased almost 100 per cent during 1921 and 1922 and the prospects are for a still greater increase in percentage during the coming year.

It has been conservatively estimated that more than one million electric sign outlets were placed on lighting company's lines in California during 1922. The majority of these outlets received 10-watt lamps. However, there were many instances where 25 and 50-watt mill type daylight lamps were used and averaging over 27,000 receptacles in actual signs it was found that the wattage per receptacle ran 15 2/7. The past year has noticed a great rush to use larger wattage lamps. This is satisfactory, and a good thing in the case of large letters, but it has been found that the reading value of the exposed lamp electric sign in sizes of letters less than 20 in. is not improved by increasing the wattage of the lamps above 10 watts, which was the old standard. Using 25 or 50-watt lamps merely makes a brilliant glare, but does not improve the long distance readability of the sign. In fact, it does sometimes the opposite, making such signs less readable at a distance. This is especially true with signs of porcelain enamelled steel background of high reflecting power.

For signs with letters above 20 in. in height which are of the exposed lamp variety 25-watt mill type Mazda lamps are entirely satisfactory and the proper thing to use. Above three-foot letters the 25-watt mill type lamp is the best. While on this subject of lamps it is to be noticed that the S14 10-watt sign lamps have proven most satisfactory, a considerable improvement in this type of lamp having been noticed during the past two years. The average life is well above one thousand hours. It will be recalled that when this lamp was first placed on the market its average life was hardly half of that figure. Furthermore, the use of the ring type filament in this bulb lamp has proven a boon. The filament is substantially fixed and has added probably 25 per cent to the life of the lamp. The improvement in the 10-watt sign lamp has resulted in doing away almost entirely with the 5-watt, 11-volt lamp and sign lighting transformers.

In the design of electric signs there is an increasing tendency to use interior lighted signs for the reading matter and to embellish the same with chaser borders of spectacular effects. On all letters under two feet in height the readability of the sign in the day time is improved if it is of the interior lighted variety, having the faces of the sign constructed of raised opal glass electric letters. There is an increasing demand for colors and pleasing effects brought about by colored lamps and color caps.

The greatest need of the electrical sign business on the Pacific Coast appears to be a widespread dissemination of simple and easy estimating figures so that everyone in the electrical business will be able to make a rough estimate of what an electric sign may be purchased for. Countless opportunities are lost on the part of electric lighting companies,

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electrical contractors and dealers, because they are unable to give a prospect a rough or approximate price on about what an electric sign will cost. The delay in referring this matter to a sign manufacturer is what causes the customer to grow cold and oftentimes the figures received from the manufacturer are so different from what the customer expected to pay that he becomes out of sympathy with the idea of purchasing an electric sign.

Interior lighted signs of the embossed opal glass letter variety will sell for about $1 per letter per linear inch of height—that is to say, a 12-in. letter, $12; a 6-in. letter, $6. A double-face 12-in. "DRUGS" sign would therefore be about $120. Signs estimated in this way will be probably over the actual cost rather than under it, and might include normal freight and erection on the face of the building. Lamp letter effects on signs will run from 70c per outlet to $1.35 per outlet, depending upon the complication of the design. Motor operated flashers will cost from $50 upwards, depending upon complications. Very satisfactory on-and-off thermostatic flashers in which the thermal circuit operates a relay solenoid which opens the main circuit, are obtainable at about half the price of motor-operated flashers. Roof signs are composed of skeleton letters costing about $10 per foot of height—that is to say, $40 for a 4-ft. letter of the V trough or block channel type. These are mounted on steel frame works which cost about 75c. to $1.50 per sq. ft. of gross area of the frame work. The former figure is for low frames and the latter figure for high frames. Such prices will comprise ordinary erection on the building. Porcelain enamelled steel signs will sell for about 20 per cent above previously stated figures.

Considerable progress has been made during the past year in the use of gun cotton base celluloid enamel for painting electric signs. This has improved the wearing qualities of painted signs and gives these signs the same finish now generally used in refinishing automobiles. The use of pressed metal ornamentation, either in copper or zinc, is becoming quite general, so that signs produced by reliable manufacturers are works of art and an ornament to any building.

A depressing effect upon the electric sign industry has been the existence of the small underfinanced electric sign builder who is usually also in the business of making painted signs and cloth banners and who makes a few electric signs a year. Due to the fact that the average merchant purchases only one or two electric signs during his business lifetime he is not in position to discriminate between the large, well managed company and the curbstone operator. Such a condition will be materially remedied when the forthcoming Electrical Safety Code of the Industrial Accident Commission of the State of California has been effected. Such a code will provide for rigid standards in the construction of electric signs so that it will be necessary for the small manufacturer to install better machinery and testing equipment and to procure the underwriters' label on his sign. This will improve the standards of the business very materially.

An important point in connection with the design of electric signs and its application to advertising service is rarely understood and recognized. The average customer will come to the sign manufacturer with some trademark or script monogram which he has spent a greater deal of money capitalizing in connection with his printed advertising. He will want that monogram reproduced exactly in his electric sign and will not be satisfied with any other suggestion. Due to irradiation or the tendency of light to spread when viewed at a distance, such monograms or script lettering becomes practically worthless, but it is difficult to explain this to the customer. For the same reason there is a tendency on the part of inexperienced electric sign manufacturers to manufacture signs with letters altogether too close together or of too narrow a stroke. A 6-ft. letter, properly spaced, can be read much farther than a 10-ft. letter improperly designed and improperly spaced.

To prevent irradiation effects the distance between each letter in a row of horizontal letters on electric signs should be at least one-half of the width of any single letter, and preferably one-half of the height of a single letter. By comparison of this with the arrangement of letters on a printed page it will be observed that the spacing of electric sign letters must be very much more liberal than the spacing of letters on a printed page of billboard. Purchasers of electric signs usually obtain competitive bids merely specifying height of letter and number of letters in the sign and do not realize that by doing so they are placing the high-grade manufacturers of electric signs at a disadvantage, as a sign properly designated might easily cost 50 per cent to 100 per cent more than a sign improperly designed. The principle is better enunciated by stating that it is impossible to produce an exact reproduction of a printed trademark in an electric sign and have that electric sign produce the same effect on the eye that a view of the printed trademark does. When the trademark is to be reproduced on an electric sign it is necessary to materially alter the same in order that it may produce the identical trademark effect on the human eye, as all irradiation effects must be neutralized.

With reference to billboard illumination, these boards represent one of the largest users of electricity in the advertising field next to the electric sign. The bulletin companies have found that their greatest percentage of clean cut profit has been on the illuminated bulletin, charges being from $20 to $50 per month extra for illumination. Wherever billboards and bulletins are found within possible reach of electricity about 90 per cent of them are now illuminated from dusk until midnight.

On 50-ft. bulletins with standard porcelain enamelled billboard reflectors carrying 100-watt lamps, ideal illumination has been found when the reflectors are placed about 6 ft. in front of the surface on 7-ft. 6 in. centers, the base of the reflectors being turned at about 45 degrees. A 50-ft. bulletin requires eight reflectors. Current consumption is therefore 800 watts or 4 kw.-hr. per night, operating five hours, making a daily cost of from 12c to 40c, according to the rate. It is found on the varnished bulletin surfaces that a glare exists to which some objection has been made. Hence wherever possible the bulletins are being flood lighted. However, this method of illumination is more costly and space is seldom available for the placing of flood lights. By placing flood lights on 18-ft. centers, 15 ft. in front of the bulletin, satisfactory illumination is obtained. This illumination materially reduces the glare. Five hundred watt units are found satisfactory.

There is no conflict between the electrically illuminated billboard and the electric sign. Each has its distinctive field. The illuminated billboard is distinctly a short reading proposition. Regardless of how large the letters may be on the background of an illuminated billboard they cannot be seen or recognized at more than one-fourth the distance of a similar height of letter when directly illuminated by either exposed sockets or interior lights on the electric sign plan. The reason for this is due to the glare and reflection from dark surfaces as well as light when such surfaces are illuminated by billboard reflectors or flood lights. This is the explanation of the failure to obtain satisfactory results from plain painted signs which are illuminated with billboard reflectors. The billboard, on the other hand, is in a class by itself in providing the greatest efficiency in producing an advertising message embodying a large number of words to be read at night from a short distance at a minimum cost.

Business Possibilities in Residence Lighting

By R. S. Prussia*

AN analysis of the electrical contracting end of the electraical industry develops the fact that residence lighting is the backbone of a contractor-dealers' business. Irrespective of business conditions or industrial activity, homes are always in use and new ones are constantly being built. The housing shortage is still a nation-wide problem, and it alone constitutes a field of vast proportions. One has but to open his eyes to the feverish building activities of the present day to realize why contractors and fixture dealers wear the smile that accompanies a busy season. There is the further field of the eight million homes that are already wired for electricity. Based on the survey by an authority pre-eminent in residence lighting concerning the "middle class" home it is safe to assume that the average home of today is less than "half-lighted."

From the 1920 census it was found that 54 per cent of our population live in rented homes, which leads to the assumption that approximately one-half of our people live in apartments or flats. Also, practically one-half of the country's population live in cities of 2,500 or over, hence it may be assumed that of the eight million homes already wired in the United States, the majority are city homes.

These figures are verified completely in an analysis by one of the foremost western central stations which inquired into the value of the residence lighting load. It was found that 47 per cent of the total revenue accrued from the sale of electrical energy was derived from the lighting load. Further, this residence lighting load represents 33.6 per cent of the total connected load.

It is obvious from the foregoing that there is a tremendous field alone from homes already wired, if these homes are to be taken out of the "half-lighted" class and given adequate and proper illumination. If the new homes building or to be built carry specifications for correct lighting it will increase very materially the comfort of those homes, to say nothing of the increased profits therefrom to fixture dealers and contractors.

How to Reach the Field

In the past the greatest drawback to progress in home lighting has been due to a concentration upon lamps and fixtures. Ask almost anyone to judge the lighting of a room and he will immediately turn his attention to the fixtures instead of viewing the room as a whole.

Fixtures should be selected on the same basis as plans are made for decorations. The decorator uses paint and wall paper to produce an effect or atmosphere in a room, and likewise a fixture dealer should recommend a fixture with proper lighting which will bring out the decorator's scheme and at the same time harmonize with the decorations. Too much attention in the past has been spent in trying to secure harmony of fixtures at the expense of proper lighting efficiency to bring out the decorative scheme, which tends to nullify the decorator's effort. We should direct the householders' attention to the expressiveness of light or to the effect of lighting upon the mood or expression of the room.

If we are to develop the residence lighting business it is important that we popularize lighting by making it proper and adequate, also by emphasizing the charm of lighting effects and by showing that lighting can be designed to meet the variety of requirements found in the home. Until recently the depths of the requirements and possibilities of residence lighting were not sounded, and as a consequence there was no uniformity of recommendations, which only added confusion to the indifference already possessed by the householder.

Important as is the lighting of a home in securing the ultimate of comfort and decorative effect, it seems inconsistent with good judgment when it becomes known that of homes built it is found that the allocation of expenditure for lighting averages approximately 1 per cent of the total building cost, whereas the decoration cost is from 5 to 7 per cent. To allow at least 2 per cent lighting would enhance the value of the decoration cost in a far greater proportion than the ratio of 2 to 1 would indicate.

It therefore behooves all those interested in the residence lighting field to acquaint themselves with the possibilities in residence lighting art of the present day and to disseminate this knowledge to architects, builders and, most important of all, to the householder whenever and wherever possible. By so doing, a tangible and material benefit to the contractor-dealer and fixture dealer's bank account is accomplished. It follows that the satisfied householder becomes a living advertiser for whatever concern accomplishes this satisfactory service for him.

Methods of Securing This Business

Experience has shown that actual demonstrations of lighting are extremely more effective than any method of mere description. Very few people realize the possibilities of lighting from a standpoint of ethics or of utility. It is as difficult to describe the possibilities of residence lighting to a person who has not seen them as it would be to describe to a Hottentot the beauty of Caruso's singing.

The best method for selling residence lighting effects is by the medium of demonstration booths or rooms wherein can be shown proper and improper methods, fixtures and lamps. Quite a number of prominent fixture dealers have increased their sales and add much to their reputation through this method because the householder is allowed to visualize the result of proper and improper lighting effect.

Then, again, the electric home is a most potent factor in selling the properly planned residence lighting idea, and the cost has been found to be ridiculously low for the result.

Special campaigns featuring one room at a time are very successful. For instance, a survey develops that 71 per cent of the kitchens are equipped with drop cord outlets. A campaign featuring an enclosing unit of good diffusing glassware creates a wonderful desire upon the housewife for better lighting in her home workshop. Only 9 per cent of our homes are equipped with the dome for lighting of dining rooms, which, by the way, is the correct idea for lighting of dining rooms, taken from any angle. This idea alone creates a tremendous field for the merchandiser. And so on for each other room of the home.

The residence customer, buying for personal use through the economic ups and downs of the country, is affected but little by such changes, and hence is a dependable source of revenue. The contractor-dealer and central station, also fixture dealer, can profit greatly by attacking this awaiting field, and by obtaining it, they will be doing a favor to the customer by making his home more convenient and cheerful and therefore a better place in which to live.

In closing, the writer wishes to place credit where credit is due for much of the foregoing data, and therefore offers his appreciation to Mr. M. Luckiesh, chairman of Residence Lighting Division of the National Electric Light Association.

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The Lighting of Retail Stores

By R. S. Prussia*

BETTER store lighting is the merchants' easiest step toward better sales. An engineer employed by one of Chicago's largest department stores recently remarked that when the store wished to dispose of a line of goods, they were moved to a section where lighting intensities were many times higher than generally prevailed throughout the store. Instinctively, they must have realized that the psychological effect of the increased intensity would have its result in moving the merchandise.

Successful retailing consists of three fundamental progressions:

I. The attracting of passers-by to arouse curiosity and interest.

II. The appealing demonstration of merchandise to arouse desire.

III. The selling to purchasers to gain their enduring satisfaction.

Proper illumination will materially assist the merchant in accomplishing each of these results, and keen competition demands that it, like every other advantage, be used.

Light will not only improve the appearance of the store but can be made a pulling power in itself. Goods are displayed on the counter, in the show case, or in the window to be seen. Those that are not might as well be back on the shelf. The more of the merchandise a customer sees, the greater is the selection and variety offered to him, and the larger are the sales.

Customers whose confidence is sought by a merchant, should be allowed to examine merchandise before purchasing. By facilitating this inspection, proper lighting will assist materially and hasten the actual sale. Patrons who have to carry goods to the front door, or even home in order to see them, consume time, stock, and their patience.

Good lighting creates confidence and bespeaks quality. Successful merchants believe in good illumination—that is one prime reason why they are successful.

Out of one hundred and fifty store managers questioned regarding their illumination recently, 80 per cent stated that they were satisfied with same and the balance, or 20 per cent, were dissatisfied—at least one store out of every five is anxious for lighting service.

Another very recent survey made in many cities developed the fact that 57 per cent of the stores are poorly lighted. Such stores as cigar, shoe, millinery, ladies' clothing, piano, confectionery and furriers were found to be provided with slightly better than the recommended minimum of lighting. Other stores such as carpet, dry goods, hardware, music, drug, butcher, groceries, restaurants, bakeries, furniture and stationery all had just the minimum recommended intensity or much less.

For instance: 70 per cent of drug stores should have better lighting, the survey developing that percentage of stores investigated had less than 5-ft.-candle intensity.

Ninety-one per cent of grocery stores are lighting prospects. Less than 5 ft.-candles were found in 91 out of every 100 stores surveyed.

Sixty per cent of apparel stores have less than 9-ft.-candle intensity which would mean that 60 per cent of the apparel stores should have better lighting.

Instances of this kind could be cited to great length, however, only one further but very striking example will be furnished. In 1921 the Commonwealth Edison Company investigated 1,000 stores selected at random. The average intensity for these stores was very low. Only 25 per cent had 5 ft.-candles or more. In 1922, a thorough campaign of sales effort on stores was made in which a standard of 10 ft.-candles was aimed at. This campaign added 45 per cent to the store lighting revenue of this central station.

Strange as it may seem, it is necessary to publish the fact that 26 per cent of store interiors are still lighted by Mazda B or Vacuum type lamps. To provide for the more efficient Mazda "C" type lamps, new illumination layout specifications should be secured by storekeepers which is another field of endeavor that should prove lucrative.

The fundamental basis on which a large number of business decisions are formed, is a comparison between a merchant's own practice and that of his competitors and others engaged in the same or similar lines of business.

It is an acknowledged fact that high intensities permit a proper and speedy examination of merchandise, thus speeding up the operation of selling. Employees are enabled to find goods quickly; an improvement in the esprit de corps and personal appearance of the employees is noticeable in those stores having a better class of illumination.

The responsibility for the lighting equipment is usually in the hands of the store engineer or electrician, whose initiative in advocating changes in lighting is tempered by the constant instructions of the management to keep down expenses. Unfortunately, the source of most of their information on the lighting subject is the fixture salesman. The fixture or specialty salesman constantly drills into his customers' ears the fact that his fixture has a greater efficiency than that of his competitor, with the result that there is a tendency to reduce sizes of units installed, rather than to increase them.

The average merchant thinks of lighting in terms of profit to his store. The Marshall-Field Company of Chicago recently said, "Good lighting increases sales in a store just as it increases production in a factory. Increases of illumination of 6 to 10 ft.-candles have increased the cost of lighting by 1 per cent and have been found to promote the sales by 6 to 7 per cent."

Better store illumination has been a subject of increasing interest during the past year with merchants who have been in a very receptive mood for ideas which would tend to better their lighting conditions. As a rule, the merchant of today is cognizant of the ability of good lighting to draw and hold tra de. Any individual with sufficient lighting knowledge to talk intelligently and who has proper credentials, has but to ask permission to check up and study the lighting of a merchant's store to arouse the keenest of interest. So many surveys of lighting conditions, particularly in the merchandising field, have been conducted lately of which merchants are becoming more and more familiar that a merchant is very keen in having his store surveyed impartially, as he hopes after the survey is made to acquire the result of the findings for his personal benefit.

The proper use of foot-candle meter in checking sections of the store adds materially to the interest of the merchant and gains his confidence for the salesmen. After a systematic check of existing lighting levels in the store has been made, when presented to the average merchant, together with recommended levels in modern practice as to lighting a store of his classification, it will generally be the means of opening of negotiations towards providing better illumination.

*Commercial and Residential Illumination Sub-committee of Commercial Committee: R. S. Prussia, chairman; L. J. Lasar, vice-chairman; C. O. Martin, Clark Baker, Chas. T. Phillips, Paul D. Howse, Tracy W. Simpson.

By this means the merchant does not realize that the clever salesman, under the guise of surveying his store as one of many to be surveyed, is in reality surveying his store for purposes of demonstrating to the merchant that his own particular store is the one which needs changing.

Too often, the better class of store derives its lighting from some very ornate luminaire, which has been designed either by an architect or some manufacturer of lighting fixtures who had in mind primarily the building of some expensive fixture with little thought being given to the result from the standpoint of lighting, and this point should be brought out in the survey of any merchant's store if the condition as above outlined prevails, as it does in so many cases.

A manufacturer knows to a fraction of a cent what profit he makes on a commodity. He chooses certain lines as "leaders" because they sell rapidly or because of an especially good profit margin. From time to time he changes his "leaders"—switches his main selling effort from one article to another—because of the season or condition of the market. Why this generally accepted idea in all other lines of business is not more widely followed by contractor-dealers and central stations is a mystery. Just now store lighting is the obvious "leader" for sales endeavor by those concerns. It should be a leader, first, because it can be easily sold at the present time; second, because it is a big volume business, and, third, because it is an extremely profitable business.

Office Building and Flood Lighting

By Charles T. Phillips*

THE lighting of an office building offers a field for study, with possibilities of increasing the off-peak load for the central station. The office building load is not as desirable as a great many other classes of service, due to the fact that the load factor is low and the lighting peak is usually superimposed upon industrial and other afternoon loads, and this peak is of short duration.

There is no doubt of there being a fruitful field for improvement and this can, to a great extent, be accomplished by cooperation with the many manufacturers of electrical energy consuming devices used in offices, such as electric typewriters, fans, adding machines, dictaphones, mailing and stamping machines, addressing machines, etc. These devices are in constant use during business hours and, while the individual energy consumption is small, the combined load of a large number of these appliancs may be well worth considering.

To supplement the daylight load of the office building there are numerous electrically-driven labor-saving devices that are used after working hours. These are portable vacuum machines, where the building is not piped for the stationary type, metal polishers and floor scrubbers.

The proper lighting of the office has not been given very much attention. There is usually some type of lighting fixture, but in the majority of instances these fixtures merely serve for general lighting and very indifferent lighting, as a rule.

In a large number of offices the daylight is not good, especially in the afternoon, and the public could be educated to the fact that good artificial lighting is superior to poor natural light.

An office well lighted with a high intensity of artificial light during the entire working day would certainly be an incentive for higher efficiency from clerical help than one that had only sufficient natural light during a few hours of the working day and dependence had to be placed on local lighting the balance of the time.

The advantages of good general lighting over local lights are many and the subject has been treated in various articles in the technical press, but unfortunately the office employer has not been educated to this fact.

It has become the task of the central station, the progressive lighting fixture manufacturer, the contractor and the consulting engineer to be the educator in this matter.

The central station has the most to gain in this phase of lighting as this class of service will assist in raising the load factor to a desirable degree.

The best time to attack the problem of more income and a high load factor from the office building is in the planning of the building. Each office should have the proper number of ceiling outlets of sufficient capacity for any type of lighting fixture that may be used, and, if possible, the type of lighting fixtures should be decided upon at the time electric wiring plans are being prepared. Recently, among some architects, it has been the practice to let the lighting fixture contract at the time the contracts for the building are let. Sometimes the lighting fixtures are included in the wiring specifications.

There should be a generous supply of convenience outlets. Small offices should have at least two, and, in larger office space, there should be one at least in every ten feet in the base board and at least two on every column. These outlets should have a capacity of 100 watts each.

Another source of income which has become very popular lately is flood lighting. This is a fruitful field, as the burning hours are long and the energy consumption is high.

Any structure finished in white or light tones can usually be flood lighted, if a suitable point or points can be obtained for locating the light projectors.

Practically every person is familiar with this class of lighting and it should not be a difficult task to convince the average owner of a store, office building or factory that the advertising value of this class of lighting will more than pay for the cost.

Churches and public buildings also lend themselves to this class of lighting; in fact, the field is unlimited.

Beautiful effects can be obtained by the use of color screens or lamps and various color combinations can be made and changed as desired.

The flood lighting load, if desirable, can be arranged to follow the afternoon or evening peak. The hours can be from between 5:30 and 8 o'clock, depending upon the season, until midnight, or even later, and, in some instances, all night.

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The Value of Better Show Window Lighting

By Clark Baker*

HOW big a part show window lighting plays in the annual central station revenue is difficult to determine accurately. Some idea of it may be gathered, however, from the known lamp demand in the commercial field and from the generally accepted figures as to the amount of central station load and revenue represented by lighting as against power load. Also by dividing this commercial lighting into its various fields, such as store lighting, window lighting, sign lighting, etc.

In comparing show window lighting with other lighting fields, residential lighting demand has increased during the last two years at a rapid rate, due principally to an excessive housing shortage. Not only has the building rate been rapid, but very many old homes have been wired. Even

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with this boom, residential lighting still plays second fiddle to commercial lighting (of which show window lighting is a very important part) in total kilowatt-hour load and annual revenue.

The reason is easy to comprehend. The average store, we learn, has a connected load of 2 kw. and a load factor of five hours a day. The average home has a connected load of 762 watts and a load factor of 1½ hours per day. Assuming 40 per cent of the home load is in appliances, and that a rather small part of the connected load in the home is in use at any one time while the entire store and window lighting load is effective during the major part of five hours per day, it takes a lot of homes to equal one store when it comes to a consideration of central station revenue.

The industrial lighting field is excellent, but not so large at present as store and window lighting. With factories working at 60 and 70 per cent of capacity, and with comparatively few running night shifts, the lighting income from this source is smaller than it once was.

In order for the central station solicitor to cash in on home-lighting demand he must necessarily have to wait for an educational advertising program to become effective which takes time and is too broad a field for the lighting sales specialist to pay his way. But in the store window lighting field the central station lighting salesman will find things to his taste. Merchants everywhere for the past year have been in a most favorable frame of mind toward good illumination. It is almost impossible to find a merchant who will not readily admit the importance of illumination in drawing and holding trade. And competition is keen—a big factor in making the merchants eager to invest in anything within reason that will make his window outstanding and bring new buyers into his store.

Modern merchandising demands good illumination and good illumination must be efficient illumination. People will invariably pass up a store that is poorly or inadequately lighted, where, on the other hand, they will be attracted by a well-lighted show window. It follows the interior must be equally attractive. A recent survey indicates the following in store-window lighting: Good, 10 per cent; fair, 18 per cent, and poor, 72 per cent.

There may be discrepancies in these figures when applied to any particularly locality, but they do indicate that good window lighting is the exception rather than the rule.

It has just been learned what the actual drawing power of different levels of illumination is in show windows. This is the result of several tests which have been given much publicity, one in particular which shows that an increase in illumination from 15 to 40 foot-candles in a show window had an average attracting power of 24 per cent. Again, raising this illumination from a 40-foot-candle level to a 100-foot-candle level shows a further attracting power of 18 per cent. Therefore, 24 per cent plus 18 per cent equals 42 per cent increased drawing power, going from the lowest level of illumination in this test to the highest level of illumination, or, in other words, 42 per cent increased attracting power going from 15 ft.-candles to 100 ft.-candles.

It has been estimated and is assumed by some of the largest merchandisers that 40-foot-candle intensity in a show window with an attractive display is responsible for about $100 per hour. Energy cost per one thousand hours at $.05 per kw.-hr. for a 40-ft.-candle intensity window is about $70.

Increasing this intensity from 40 to 100 ft.-candles increase the attracting power 18 per cent of $18 an hour, and the energy cost per 1,000 hours at $.05 per kw-hr. has increased to $175. This should make its appeal to the central station solicitor.

Another development in show-window lighting is the overcoming of daylight reflections. In order to accomplish this it will be necessary to light certain objects to intensities of from 1,000 to 2,000 ft.-candles. It is obvious to a central station man what this would mean in load factor and revenue.

Polished plate glass under certain conditions forms a very excellent mirror. With a suitable background bright objects in front of the glass are reflected in minute detail, and many times does the magician stake his success upon the fact that the prominence of such images varies primarily with the relative brightness of the objects behind the glass and those which are reflected in it. Even with a comparatively light background reflections of objects having a still greater brightness can be seen very well. The most familiar instance of this effect is in the plate glass front of our show windows. When objects on or across the street are well illuminated the reflections are very evident in almost every window; when they are in bright sunlight and the background and trim of the window are dark, the relative strength of the reflections is such as to practically eliminate portions of the display. An effect of this character is so serious that the merchant will go to almost any length to eliminate it.

Show windows, particularly those located upon an important busy street, have a high advertising value, variously estimated by different proprietors at from $50,000 to $150,000 per year, $1,000 per week, $10 profit per hour, etc., depending upon the number, size and location of the windows. Without analyzing or comparing these estimates it is evident that a high value is placed upon show windows by the owners, and that whatever tends to reduce the attractiveness or visibility of the display is decidedly unwelcome.

In a number of cases an attempt has been made to do away with these troublesome reflections by the use of a curved plate glass. In general, this method is highly satisfactory as regards the elimination of reflections. It has not, however, been extensively employed, possibly because the use of curved glass requires that the lower edge of the glass be located from 18 inches to 2 feet behind what would ordinarily be the front line of the window. This not only gives a sense of distance to the observers, but furthermore the display being necessarily located further back receives less natural light.

It has long been realized that if it were possible to install in the window a sufficiently high intensity of artificial illumination, one which would provide a brightness of the objects in the window materially greater than the brightness of the reflected object, much of the veiling effect now encountered would be eliminated. Many have tried to accomplish this result by turning on the regular show window lights, but the results are usually disappointing. The reason for this, although frequently overlooked, becomes at once evident when one considers the relative brightness involved. Objects in bright sunlight are illuminated to perhaps 5,000 ft.-candles and their images on the plate glass appear to be at least one-tenth as bright as the building themselves; 50 ft.-candles or even 100 ft.-candles of artificial light inside the window can scarcely be expected to overcome brightness of 500 ft.-candles on the surface of the glass. Artificial illuminations of from 1,000 to 2,000 ft.-candles would be of more nearly the correct order of magnitude.

The average merchant thinks of light in terms of profit to his store. He can be most easily sold once he is convinced that better show window illumination has an actual dollars and cents pulling power, and will speed up sales, also stimulate the sale of slow-moving goods, and, likewise, give his store a better reputation.

Whatever other opportunities may present themselves in 1923, it seems hardly possible that any more profitable opening for increased central station income can arise than better show window lighting. It is something that any central station may cash in upon immediately by reason that the three Mazda manufacturers have an extensive advertising program in effect right now on store and window lighting.

An Analysis of Data on Cooking, Water and Air Heating

By J. W. Wrenn*

IN order to have the data presented in this report as complete as possible, no information was requested from the various member companies until after they had had an opportunity of closing their books for 1922 and making their annual reports. Unfortunately, many companies were unable to give all information asked for, but all furnished what was available. The results of questionnaires sent out on the subject are shown in Tables I, II and III. It was found at the end of 1922 that the companies reporting had 10,587 ranges, 7,269 water heaters and 120 bake ovens connected to their lines.

After a careful analysis of the data contained in the accompanying tables, the committee makes the following recommendations:

Ranges

The increase in the number of installations shown by the majority of the reporting companies indicates that the value of this load is appreciated by the companies and that the consumer is commencing to realize the many advantages of cooking electrically. The new rates recently put into effect in several districts in California will encourage this load. Under these rates the cost of operation compares very favorably with that of other and less desirable fuels.

An attempt was made to secure data in reference to the apartment house load. Unfortunately, the major companies did not have sufficient of this information available to be of statistical value.

The information reported shows that the average usage of apartment houses is considerably less than the ordinary home installation. Several installations averaged from 72 kw-hr. per month per range to 125 kw-hr. This business seems of considerable importance and greater attention should be given to it. It is frequently handled through one meter, the owner purchasing the sub-meters used for each apartment. Complaints are few and its educational value to the general public considerable.

In the central portion of the state where more attention has been given towards securing this load, it has been found that apartments equipped with electric ranges rent as readily as those where other types are installed.

The load factors are very interesting and data along this line should be secured by all companies. That submitted, while interesting, was not enough to enable us to include same in this report. The maximum demand, compared with the connected load, is comparatively small.

It is estimated that there are now upwards of 100 apartment houses in this state fully equipped with electric ranges and considerable data should be available for the benefit of the industry.

The manufacturers report an increase in business for the year 1922 as compared with 1921, ranging from 40 to 60 per cent. This does not include those who came on this market during 1922.

Several manufacturers represented here are again establishing their agencies and all are looking forward to largely increased sales during 1923. Some of the older manufacturers estimate their prospective increase as high as 100 per cent.

At least one new range manufactured on the coast will be placed on the market this year and several local manufacturers are considering electric ranges for the near future.

Twenty schools are reported as having their domestic science rooms equipped electrically, six more partly so, and a number of others now building have specifications calling for complete equipment.

To encourage employees in the industry to use electric ranges in their homes, several manufacturers have made especially low prices on ranges sold to such employees.

Electric Water Heaters

The increase in the number of installations of this character seems to be quite satisfactory. Owing to unfavorable rates in various portions of the territory the increase is not as great as the convenience of the electric water heater would warrant. With more favorable rates and greater effort this would become a larger source of revenue.

Charts submitted show that the load operates largely on off-peak and continues on the automatic type until approximately three o'clock in the morning, and that the largest quantity of hot water is used between 9 and 10 p.m. and the next largest amount between 9 and 10 a.m.

A new water heater which the manufacturers have spent several years in developing is to be placed on the market in the near future. The manufacturers claim econ-

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Table I—Domestic and Apartment House Installations, Ranges Only

	Total Installed		Increase	Average Annual Usage and Income		
	1922	1921	%	Kw-hr.	Total	Per kw-hr.
California Oregon Power Co.	389	322	21	1,692	$62.64	.037
Elk Lamoille Power Co.	21	9	133	538	22.37	.0416
Great Western Power Co.	1,472	1,000	47	1,320	46.20	.035
Los Angeles Gas & Electric Corp.	60	50	20	1,384	73.24	.0529
Pacific Gas & Electric Co.	2,665	1,865	43	1,800	63.00	.035
San Diego Consolidated Gas & Electric Co.	140	138	...	2,131	63.84	.03
Southern Sierras Power Co.	530	420	26	1,800	85.85	.0477
San Joaquin Light & Power Co.	190	84	126	3,356	107.31	.032
Truckee River Power Co.	115	102	13	1,368	57.90	.0433
Vallejo Electric Light & Power Co.	89	83	7	1,754	57.40	.0327
Western States Gas & Electric Co.	147	110	33	2,680	74.50	.0278
Ranges and Water Heaters Combined						
California Oregon Power Co.	560	463	21	8,892	$101.88	.0114
Coast Counties Gas & Electric Co.	29	23	26	1,336	58.46	.0438
Coast Valleys Gas & Electric Co.	85	66	29	.....	.....	.....
San Diego Consolidated Gas & Electric Co.	58	60	...	3,631	107.00	.0295
Southern Sierras Power Co.	24	.....	...	3,050	132.48	.0434
San Joaquin Light & Power Co.	116	44	164	5,799	144.19	.0249
Southern California Edison Co.	3,851	3,367	14	2,114	58.43	.0276
Western States Gas & Electric Co.	67	54	24	4,060	107.90	.0263

Table II—Domestic Water Heaters Only

	Total Installed 1922	1921	Increase %	Average Annual Usage and Income Kw-hr.	Total	Per kw-hr.
California Oregon Power Co.	95	79	20	7,095	$39.24	.0055
Great Western Power Co.	770	440	75	5,280	49.20	.0093
Los Angeles Gas & Electric Corp.	5	4	25	1,978	85.14	.043
Pacific Gas & Electric Co.	1,300	900	44	4,500	90.00	.02
San Diego Consolidated Gas & Electric Co.	15	14	7	2,210	66.31	.03
Southern Sierras Power Co.	146	.....	...	1,250	59.85	.0479
San Joaquin Light & Power Co.	31	13	138	2,393	80.96	.0338
Truckee River Power Co.	102	33	209	.....	.....	.....
Vallejo Electric Light & Power Co.	8	3	166	4,440	132.20	.03
Western States Gas & Electric Co.	7	12	...	3,750	93.00	.0248

omy as to operation and first cost.

It is quite evident from the data sent in by members that the electric water heating load has been found to have very favorable load characteristics and to produce proportionately large revenue per kilowatt of connected load.

Water heaters installed in homes where ranges only have been used formerly increased the revenue from 150 to 300 per cent without necessitating any additional transformer capacity.

Apartment houses where electric water heaters are supplying continuous hot water service are earning lower average rates on the usual power schedules by reason of the load characteristics, and thereby reducing the cost per kw-hr. to the consumer on his cooking and air heating.

It is quite evident that an electric water heating system, carefully designed and properly installed, not only offers a load with a unity power factor, but may be designed in respect to relationship between storage and heater capacity so that the load factor is extremely high and that relatively small transformer capacity is required. By time switching the load to keep it off the peak a very high load factor is possible without impairing the service to the consumer.

One power company uses the following schedule as a guide for determining proper boiler and heater capacity for apartment houses:

No. of Apartments	Heater Capacity per Apartment	Boiler Capacity per Apartment Minimum	Maximum
2 or 3	1,500 watts	30 gal.	40 gal.
4 or 5	1,250 "	30 "	40 "
6 to 11 inclusive	1,000 "	30 "	40 "
12 to 14 "	900 "	25 "	30 "
15 to 19 "	800 "	25 "	30 "
20 to 50 "	750 "	25 "	30 "
Over 50 "	700 "	20 "	30 "

Boilers to be lagged with at least 2 in. of approved insulating material.

Several power companies are recommending in domestic water heating installations, the installation of a tank sectionalizer or limiting valve in connection with automatic electric water heaters. This valve serves to limit the amount of water which is kept continuously hot in the boiler, and it is claimed that it reduces the radiation losses about 50 per cent.

A very small automatic water heater which is integral with a small capacity insulated copper boiler holding two or four gallons of water and designed to operate from a lighting circuit, is being used extensively in offices and other places where a very limited quantity of extremely hot water is desired. This type of heater supplies continuous hot water service at a very small cost.

Bake Ovens

While reports indicate that several companies have been active in increasing their load in this line, it does not seem to have received the attention it warrants. The load can be made largely an off-peak one, and the revenue derived compares very favorably with any industrial installation. Being a steady load during its period of operation, and operating continuously over long periods of time, it is far more desirable than a motor load. Further, an electric oven operated to the best advantage, is economical as to fuel costs, and the product is superior to that obtained with other types of fuel.

Unfortunately, but little data was obtainable, as the majority of installations reported were metered in connection with other loads—no segregation of the ovens having been made.

This business should receive greater attention, even to the extent of having a man especially detailed to assist dealers in placing them on the lines. Immediate results, however, should not be expected, but the results of a year's work by a good electrical oven man would be very satisfactory to the average company, this being a case not so much of the connected load as of the total usage per annum.

Commercial

These consist principally of installations in restaurants, cafes, etc., of so-called heavy duty equipment of ranges, broilers, cake griddles, waffle irons, toasters, rotisseries, etc., and are rapidly growing in favor as they become better known.

Installations reported on are as follows:

Old Faithful Grill, Fresno, Calif.:
Connected load, 42.3 kw.; average monthly use, 8,640 kw-hr.

Hansard's Grill, Merced, Calif.:
Connected load, 61 kw.

Electric Grill, San Francisco:

	Kw.
1 Water Heater	5
1 Griddle	9
1 Waffle Baker	6
1 Urn Heater	3
1 Urn Heater	2
Connected load	25

Union League Club, San Francisco:

3 22-kv. Hotel Ranges	66
1 Broiler	10
1 Bake Oven	9.5
1 Toaster	3
1 Griddle	6
1 Egg Boiler	3
1 Waffle Iron	6
Connected load	103.5

Camille Mailhebuau, San Francisco:

2 22-kv. Hotel Ranges	44
1 " Broiler	10
1 " Salamander	5
2 " Urn Heaters	6
1 Water Heater	5
Connected load	70

Table III—Bake Ovens

	No. Installed	Annual Usage kw.	Average Annual Revenue	Per kw-hr.
Coast Counties Gas & Electric Co.	1	12,008	$404.45	.0337
Coast Valleys Gas & Electric Co.	1	33,495	957.97	.0286
California Oregon Power Co.	3	32,724	398.40	.0122
Great Western Power Co.	10	33,275	583.31	.0175
Los Angeles Gas & Electric Corp.	1	.....	187.85	.....
Pacific Gas & Electric Co.	20	35,185	679.00	.0193
San Diego Consolidated Gas & Electric Co.	24	19,536	545.00	.0279
San Joaquin Light & Power Co.	9	33,727	568.58	.0168
Southern California Edison Co.	50	35,185	531.60	.0162
Truckee River Power Co.	1	48,000	1,234.80	.0257

Hotel Whitcomb, San Francisco:

1 Hotel Range	22
1 Waffle Iron	6
1 Broiler	5
1 Griddle	6
1 Toaster	3
Connected load	42

Lake Merced Golf Club, San Francisco:

1 Hotel Range	22
1 Bake Oven	5
1 Griddle	6
1 Waffle Iron	6
1 Steam Table	6
1 Toaster	3
5 Water Heaters	25
Connected load	73

Morrison's Grill, San Francisco:

2 Rotisseries	64
1 Bake Oven	11
1 Plate Warmer	8
Connected load	83

American Grill, Oakland:

1 Broiler	10
1 Griddle	9
1 Waffle Iron	6
1 Toaster	6.5
1 Bake Oven	9
1 Bake Oven	6
7 Urn Heaters	11.5
1 Egg Boiler	3
Connected load	61

Montgomery Flynn, Oakland:

2 Waffle Irons	12
1 Range	7
1 Toaster	6.5
Connected load	25.5

Mead's, Oakland:

2 Waffle Irons	12
1 Griddle	6
1 Toaster	6.5
1 Egg Boiler	3
Connected load	27.5

These installations are of too recent a date to have data of value connected with their operation and are mentioned here only to show the growing tendency to install heavy duty electric equipment where sales are actively pushed.

The popularity of the electric waffle iron and electric toaster is growing rapidly. Installations are giving universal satisfaction and act as entering wedges for the sale of other heavy duty equipment.

Air Heating

Enormous strides have been made in electrical air heating. With the exception of radio, probably no other part of the electrical industry on the coast has shown such rapid growth during the past year. The manufacturers report increases in orders over 1921 in varying amounts of from 300 to 500 per cent, and state that the business already secured and now in sight warrants them in believing that the increase for 1923 will be even greater over 1922. One manufacturer reports enough business already secured to keep his factory running continuously for several months to come.

The great flexibility and convenience of electrical air heating is rapidly overcoming the former fear of its cost. Unfortunately, very little data extending over a long period of time is available, but installations made during the past winter have proved so satisfactory both as to cost of operation and heating results, that the owners of such installations are now busy recommending electrical heating to their friends.

Great care has been exercised to see that heaters of the proper size were installed and where it was a question of placing heaters that were too small the orders have been refused. This has resulted in giving complete satisfaction to users, and is a policy that should be adopted by all central stations. Enough wattage should be installed to properly heat the space required in the coldest weather. Thermometers should be installed and operators instructed to turn the heaters down whenever an excess temperature has been reached. With ordinary care in the operation of the electric heater, satisfactory heating bills result. So far as we have been able to learn, not a single electric heater installation, properly installed, has been discontinued.

The Chamber of Commerce in Los Angeles is now considering using electric heat in their new building of approximately 600 rooms.

The plans of the El Bolivar apartment house at Long Beach of upward of 700 rooms call for electric heat.

The Abraham Lincoln School at Burbank has a connected heating load of 70 kw.

The Fourth Church of Christ Scientist in Oakland has a connected heating load of 40 kw.

The new school at Clarksburg will be electrically heated—connected heating load, 178 kw.

The Garden Grove School at Santa Ana has a connected heating load of 156 kw.

The new school at Esparto will be heated by electricity—connected heating load, 190 kw.

The school at Elsinore is heated by electricity—connected load, 90 kw. The trustees report complete satisfaction both as to cost of operation and results.

The Hotel Merced at Merced, Calif., is completely heated electrically.

Number of rooms	56
Average monthly usage for 6 winter months	3,606
Average monthly cost for 6 winter months	$131.34
Average income per kw-hr.	.0154
Average cost per room for heat	$2.35

Heat for the lobby is included in above.

A theater in Modesto has installed a central electric heating plant—connected load, 96 kw. As yet no operating data is available on this installation.

Stockton has a new government training school electrically heated with a connected load of 349 kw. Maximum demand to date has been 240 kw.

The First Church of Christ Scientist in San Rafael is electrically heated—connected load, 37.5 kw.

Average usage per month for 6 mos. heating period	885 kw-hr.
Average cost per month for 6 mos. heating period	$32.63
Average income per kw-hr.	.0369

Trustees report complete satisfaction as to results.

The new bank of Napa will have a connected heating load of 103 kw.

The Taylor Hotel Annex at Paso Robles has a connected heating load of 83 kw.—maximum demand, 55 kw.

San Francisco has a great many all-electric homes.

Oakland has a great many all-electric homes.

San Jose has an electric home with a connected load of 42 kw.

Sacramento has an electric home with a connected load of 71 kw.

Santa Rosa has 14 electric homes built and in prospect.

A number of apartment houses in San Francisco and Oakland are completely equipped electrically.

An institution in San Francisco is about to install a 63-kw. heating load.

The estimated cost of electrically heating two large office buildings in San Francisco is interesting:

Number of rooms	216	544
Estimated cost of air heating per year	$6,094.56	$14,035.73
Estimated cost of water heating per year	434.70	1,796.70
Estimated cost average per room per yr.	30.23	28.91
Estimated cost average per room per mo.	2.52	2.41
Estimated revenue per kw-hr.	.0152	.0153

A large electric heating installation recently made in San Francisco shows the following variable demand over the 24 hours:

Concrete building with concrete and tile floors.
Operated as show rooms—offices and factory.
Heating space approximately 400,000 cu. ft.
Inside temperature maintained at 70° F.
Connected load, 190 kw.

February 16, 1923

Time	Maximum Demand
6:30 to 6:40 a.m.	80 kw.
6:40 to 7:50	106
7:40 to 7:50	110
7:50 to 8:30	120 max. for day
8:30 to 8:50	108
8:50 to 9:50	80
9:50 to 10:10	72
10:10 to 12:40 p.m.	65
12:40 to 1:40	52
1:40 to 3:20	48
3:20 to 4:20	40
4:20 to 4:40	46
4:40 to 5:20	42
5:20 to 6:00	35
6:00 to 6:30 a.m.	30

The above was one of the cold days of the year. The following was on a warmer day:

April 5, 1923

Time	Maximum Demand
6:30 to 7:40 a.m.	10 kw.
7:40 to 7:50	48
7:50 to 8:00	60
8:00 to 8:20	75 max. for day
8:20 to 8:40	60
8:40 to 9:00	55
9:00 to 9:40	50
9:40 to 12:40 p.m.	45
12:40 to 1:30	32
1:30 to 2:40	22
2:40 to 3:30	18
3:30 to 4:10	24
4:10 to 5:00	28
5:00 to 5:30	15
5:30 to 6:00	10
6:00 to 6:30 a.m.	10

This building has large open area, is on the cold side of the street and has large glass windows. Is considered to be one of the most difficult heating jobs in the city. The management reports complete satisfaction. They are using the installation intelligently and turn the heaters down or off when full heat is not required.

The following data is on an apartment house recently completed in San Francisco, being 100 per cent electric:

33 apartments.

33 ranges—connected load, 177 kw.

4 water heaters—connected load, 24 kw. (1,000-gal. hot water storage tank.)

60 air heaters—connected load, 132.5 kw.

Lights, connected load, 20 kw.

Total connected load, 353.5 kw.

Elevators not considered, being on d.c.

Maximum Demands for 24 hours—March 24 to 25, 1923

Time	Maximum Demand
9:00 to 9:30 a.m.	28.6 kw.
9:30 to 10:00	33.2
10:00 to 10:30	27.5
10:30 to 11:00	23.0
11:00 to 11:30	22.6
11:30 to 12:30 p.m.	22.0
12:30 to 1:00	22.0
1:00 to 1:30	26.4
1:30 to 2:00	23.0
2:00 to 3:00	19.8
3:00 to 4:00	17.6
4:00 to 4:30	19.0
4:30 to 5:00	25.5
5:00 to 5:30	22.0
5:30 to 6:00	24.2
6:00 to 6:30	32.0
6:30 to 7:00	37.4
7:00 to 7:30	33.0
7:30 to 8:00	29.5
8:00 to 8:30	30.3
8:30 to 9:00	35.0
9:00 to 9:30	38.5 max. for day
9:30 to 10:00	31.0
10:00 to 10:30	24.8
10:30 to 11:00	22.5
11:00 to 11:30	22.0
11:30 to 12:00	21.0
12:00 to 1:00 a.m.	17.0
1:00 to 2:00	18.7
2:00 to 3:00	17.5
3:00 to 7:00	16.5
7:00 to 8:00	21.0
8:00 to 9:00	22.0

During colder weather the maximum demand will be somewhat increased.

DATA ON A FEW ELECTRICALLY EQUIPPED HOMES

Mr. G. H. Anderson, 661 North First St., San Jose:

	Kw.
Air heating load	42
Electric range load	8

Bills and consumption:

	Kw-hr.	
Oct., 22	570	$23.85
Nov.	1,250	30.48
Dec.	1,350	32.60

Number of rooms, eight.

Equipment designed for forty (40) degree temperature difference.

Mr. Bernard Ransom, Diablo, Calif.:

Twelve-room residence:

	Kw.
Air heating load	39
Water heater	5
Electric range	8

Bills and consumption:

	Kw-hr.	
Aug., '22	1,246	$30.71
Sept.	2,743	63.50
Oct.	2,004	48.50
Nov.	3,530	78.81
Dec.	2,616	59.75

Geo. C. Stevens, Belvedere, Calif.:

	Kw.
Air heating load	24
Water heater	5
Electric range	7

Bills and consumption:

April, 1921	$23.16	Nov.	$11.00
May	14.83	Dec.	29.59
June	17.59	Jan., '22	46.94
July	10.85	Feb.	51.18
Aug.	11.64	March	33.86
Sept.	9.82	April	25.78
Oct.	9.31		

Doctor J. F. O'Brien, 2400 Broadway, San Francisco:

	Kw.
Air heaters	22
Electric range	8
Water heater	3
Average monthly bills	$26.50
Maximum bills	35.00

Mr. H. J. Gute, San Luis and San Antonio Aves., Northbrae, Berkeley:

	Kw.
Air heating load	23
Water heater	6
Electric range	8

Bills and consumption:

	Kw-hr.			Kw-hr.	
Jan., 1921	705	$19.32	July	1,053	20.19
Feb.	1,299	32.98	Aug.	1,916	$22.28
Mar.	1,116	28.77	Sept.	1,085	25.76
April	776	20.02	Oct.	.....	20.37
May	810	20.79	Nov.	.....	21.67
June	820	20.25	Dec.	.....	33.54

The above homes depend entirely on electricity for heating, using same freely, and keep their homes warm and comfortable in the coldest weather. In estimating the heating bill due allowance should be made for the amount used for cooking and water heating.

Electricity is ideal for heating purposes in California. The coast towns require some heat practically all the year round and the interior in the cold months only. In the interior this load is replaced by the irrigation load in the summer months.

Industrial Electric Heating

By E. B. Criddle and F. O. Sievers*

IN making a survey of the possibilities of industrial heating on the Pacific Coast the subject must at first be studied in a general way. There are several viewpoints: First, the user's viewpoint; second, the central station viewpoint, and, third, the manufacturer's viewpoint.

The user of heat naturally first considers the old standard methods of heating using coal, coke, gas and steam for fuel, but is interested and will in most instances install electric heat if it can be demonstrated that electric heat will do cheaper work, do better work, do work that could not otherwise be done, and possesses sufficient collateral advantages.

Cheaper work may be produced by:

(a) Lower fuel cost.
(b) Higher fuel efficiency.
(c) High labor efficiency because of elimination of obnoxious gases, fumes and heat blasts.
(d) Change in process or more efficient handling of material by mechanical devices, this being only possible because of the nature of electric heat as a fuel. This item alone is very frequently the most important item to be considered. It usually develops that the energy costs are only a small part of the total cost of the product.
(e) Lower maintenance of oven or furnace.
(f) Ease of application.

Better work may be produced by:

(a) Accurate control of temperature.
(b) Elimination of contaminating gases and products of combustion and dirt.
(c) Better and more even distribution of heat.

Work not otherwise possible may be permitted by:

(a) Accurate control of temperature and other conditions, the source of heat being under positive control.
(b) Absence of fire or explosion risk.
(c) Greater qauntities and more intense heat can be produced electrically in a given space than by any other known means.

Collateral advantages are often not evident or visible, but are there in almost every instance and frequently are of great importance and value. They may consist of:

*Commercial Committee: Don C. Ray, chairman; A. E. Holloway, vice-chairman; R. H. Airey, R. C. Bragg, Oscar Clifford, Herbert Cram, E. B. Criddle, A. M. Frost, L. J. Lasar, A. H. Nicoll, J. F. Pollard, R. S. Prussia, H. C. Rice, H. E. Sandoval, F. O. Sievers, J. W. Wrenn.

(a) Lower fire risks.
(b) Less floor space.
(c) More healthful workrooms.
(d) Less skilled labor.
(e) Convenience in use, flexibility and portability.

Central Station Viewpoint

Electricity for industrial heating opens up a comparatively new and untouched field, the extent of same depending, of course, more or less, on the territory served. The load is a most desirable one, being greatly diversified, the load factor usually being very high, and the power factor also approaching 100 per cent. Where heat is used in factory production the equipment is usually used at least 8 hours and very often 24 hours per day. Some heat treating processes may be carried on at night, thus adding a considerable load without increasing the maximum demand.

The first step to be taken by the central station in developing this load is to secure the services of a competent commercial engineer to make a careful study or survey of the industrials in the territory. This work should be done by a man of considerable experience and ability, who is able to recognize an industrial heating prospect when he sees one. This will require a man of keen insight and vision and ability to study and analyze industrial plant operations and processes. It will be found that quite frequently processes or operations may be slightly modified, and in some instances may require radical changes to advantageously use electric heat. Because of his training, a technical man, preferably a graduate engineer, is better fitted to analyze and accurately study costs and operations.

The industrial heating load cannot be developed to any extent by merchandising methods. It should be handled by the sales engineering department.

The Manufacturer's Viewpoint

Cooperation with the manufacturer seems to be the most logical and satisfactory means to develop this field. The manufacturers of heating apparatus have specialists available and the central station will do well to take advantge of this and call on the specialist to work out any specific problem.

The smaller installations should be preferably handled by the central station engineer as the return to the power company continues as long as the device is in use, while the returns to the manufacturer consists of the immediate profit of the sale. It is obvious that for this reason the manufacturer should naturally expect cooperation by the central station to help the exploitation of these many small miscellaneous industrial appliances. Needless to say, the jobber and dealer is also expected to do their share.

The manufacturer of heating devices is ready at all times to cooperate with the machinery builder in the application of heating units to process machines, such as shoe, cigarette, box making and bread wrapping machines, which have one or more parts which must be heated. Steam and gas require extensive piping, considerable attention, and are in general not entirely satisfactory.

Field in California

Low temperature installations in this field will include:

(a) Electric bake ovens, both shelf and revolving type.
(b) Japanning and enamelling ovens.
(c) General drying purocesses.
(d) Core baking ovens.
(e) Miscellaneous uses.

(a) Considerable data covering costs of operation and merits of installations of electric bread and cake baking ovens has already been published, so no attempt will be made here to cover this subject. The central station seems to be quite active in this field and there are many manufacturers actively soliciting this business.

(b) Outside of a few large installations, electric heating for enameling and japanning has not progressed here as much as it should have. One of the main reasons for the slow growth has been due to many attempts to electrify old gas or fuel heated ovens without properly insulating the oven. Quite frequently it will be found advisable to build the electric oven smaller than the old fuel heated oven, because the material can be baked in considerably less time in the electric oven. Smaller charges and more frequent bakes during the day lessen the maximum demand and consequently show more economical operation. Properly installed ovens are giving excellent results. Installations will now be found in not only the industrial centers, but in many of the smaller communities—for example, Stockton, Fresno, Modesto and Lodi. Nearly all of the large automobile companies have standardized on electrically heated japanning ovens for their main factories and assembly plants.

(c) For dry rooms in furniture and painting departments the electric heater cannot be excelled. Care must be used here to install a relatively low temperature heater. In a great many cases electric heat can very efficiently and conveniently be used to drive off moisture where the amount of same is not too great.

(d) There are hundreds of foundries scattered all along the coast, and when you consider that very few electric core baking ovens are in use, you must realize that here is a very fertile field for work. From the standpoint of efficiency and net cost, particularly for small cores in which breakage and loss from uneven baking usually is a very considerable item, the electric core baking oven is a success. The time of baking is considerably shortened and perfectly baked cores are the usual product.

(e) There are many miscellaneous "electrically heated" devices on the market, such as glue pots, soldering irons, space heaters, immersion heaters for water, oil and other liquids; branding irons, tire vulcanizers, sterilizers, water heaters, disk stoves, matrix dryers, metal melting pots and steam boilers, also butt welders, spot welders and rivet heaters. Many of these devices are being merchandised, but only in a small way A little more effort on the part of dealers, contractors, central stations and manufacturers will make many of these devices universal. The electric rivet heater has been sadly neglected, but will come into its own as soon as the industrials realize its advantages.

High temperature installations include the following:

(a) Air tempering ovens.—The electrically heated tempering oven costs less to operate than the oil tempering bath, produces equally uniform temper in the steel and eliminates subsequent cleaning. Ovens for this work are built for operation up to 750° F., which covers the full range required for drawing and blueing carbon steel.

(b) The small tool room furnace.—For heat treating tools or small parts, such as wrist pins,piston rings, etc., small resistors type furnaces are built to operate at temperatures up to 2,000° F. The temperature is uniform from front to back and can be maintained within + 5° automatically. Its use:

1. Makes possible exact methods in the shop, factory and laboratory.
2. Permits duplication of heating conditions as often as desired.
3. Eliminates labor and attendance to hold any given temperature.
4. Prevents spoilage through inattention on the part of the operator.
5. Uses less power, as current is applied only when needed.

All in all, it is a highly useful furnace in the tool room, shop, metallurgical laboratory, or the research division of any manufacturing plant. A 10-kw. furnace costs only 4 cents per hour to maintain at a temperature of 1,500° F. where the rate is 2 cents per kw.-hr. and only 6½ cents additional to heat 50 lb. of steel.

(c) Heat treating furnaces.—Heat treating furnaces have been developed and are now in successful use in many manufacturing processes, requiring temperatures from 900° F. to 1,800° F. for hardening, drawing and annealing carbon steel, drawing high speed steel, annealing brass, copper and aluminum and baking vitreous enamels.

The advantages of electrically heated furnaces are:

1. Quality of product obtained from the electric furnace is decidedly higher.
2. Eliminates rejections due to non-conformity.
3. Atmosphere of furnace is practically neutral, thereby eliminating formation of scale.
4. Minimum labor for operating.
5. Even distribution of heat.
6. Absolute control of temperature.
7. Upkeep on an electric furnace is extremely low; only a fraction of the upkeep for a combustion furnace.
8. Loss due to breakage and warpage is reduced to a minimum.
9. Eliminates combustion gases and dirt.
10. Cost of subsequent machining operations, if required, is less, due to uniformity of heat treatment.

The Arc Furnace

Where quality and excellence are required, the electric steel melting furnace has practically supplanted the old methods. There are about 40 installations on the Pacific Coast, and most of these furnaces are operating and giving splendid results.

Due to the necessity of getting good coking coal from the East, making its cost here relatively high, and due to the abundance of the finest ores and unlimited deposit of lime rock, it will only be but a few years when the Pacific Coast will be a heavy producer of the high grade steels, the electric furnace contributing very largely to this output.

Here again considerable data have already been published, and therefore no attempt will be made here to show why the electric steel melting furnace has made such phenomenal strides as have been witnessed the last decade.

The brass melting furnace has taken a longer period to develop and the installations on the coast are relatively few. This furnace has been improved and new types are now

marketed. The high cost of fuel is easily overcome, for in comparing operating costs it is necessary to take into account not only fuel costs, but also labor, overhead, interest, depreciation, maintenance, repairs, supplies and metal losses. When all these items are properly considered there will generally be a favorable balance for the electric unit. The furnace must be wisely selected so that it will be operated to capacity a fair part of the time, showing again the necessity of thoroughly studying conditions. It is far better for the industry to grow slowly. Make sure each installation is a proper one. The manufacturer here can properly guide the central station and make the necessary recommendations.

Installations

Large Japanning Ovens

1. Durant Motors Co., Oakland:

1—3 compartment body oven built by Young Bros. Company, Detroit, Mich.

1—3 compartment body oven built by the C. M. S. Company, Tarrytown, N. Y.

1—Chassis oven built by Young Bros. Company.

1—Parts oven by Young Bros. Company.

The total connected load is approximately 2,100 kw., power consumption being in the vicinity of 10,000 kw.-hr. per day under ordinary production conditions.

The body ovens are divided into 3 compartments, each approximately 250 ft. long, holding about 20 bodies at one time, traveling along on the conveyor at a speed of about 30 in. per min., baking temperature being 250° F. To maintain uniform conditions the heating elements are divided into 6 sections and separately controlled.

The parts oven and also the chassis oven are both of the continuous conveyor type.

2. Chevrolet Motor Co., Oakland:

2—Enameling ovens, each having 200 kw. connected load, are used for enameling parts and fenders and hoods.

2—185-kw. ovens are now being installed, thus making a total connected heating load of 770 kw.

Vitreous Enamel Furnaces

Plant No. 1—Bath tub plant:

2—250-kw. "Duplex" furnaces.

3—150-kw. "Simplex" furnaces.

Total connected load, 950 kw.

The power consumption for the 150-kw. furnaces is approximately 100,000 kw.-hr. per furnace per month.

The power consumption for the 250-kw. furnaces is approximately 130,000 to 140,000 kw.-hr. per furnace per month.

Grand total, over 500,000 kw-hr. per month.

The cost of electric heat compared to oil as fuel is, of course, higher, but due to the less number of rejections, greater production and better ware, the election furnace produces a bath tub at a net lower cost.

Plant No. 2:

This plant is much smaller than the above, having only at present

2—150-kw. "Simplex" furnaces, power consumption being approximately 100,000 kw.-hr. per month per furnace, or a total of about 200,000 kw.-hr. per month.

Glass Annealing Lehr installed at Illinois Pac. Glass Co., San Francisco.

This lehr is of the conveyor type, being 5 ft. wide and 50 ft. long. The molten glass, after being moulded into shape, is put in this lehr and allowed to cool. If the cooling rate is not properly maintained, strains are set up in the glass, causing short life.

Here a very accurate temperature curve is maintained, there being several different heating sections or zones, 5 of them being automatically controlled by means of thermo couples. This lehr has a connected load of 150 kw. consumption, being about 60,000 kw.-hr. per month. This unit was to some extent an experimental one and the results have been very gratifying to the user, with the result that a still larger one is now being built, using special air circulating construction patented by the customer.

A Study of Domestic Refrigeration

By H. C. Rice*

DUE to constant advances of science and more probably the increased application of electricity, great progress has been made in the artificial production of ice and refrigeration. Electricity has made refrigeration flexible. The electrically operated ice and cold storage plant of today is generally acknowledged to be not only the most suitable but the most economical from the standpoint of operation. However, the small domestic refrigerator has presented to the engineer a difficult problem and this "domestic refrigerator" called in counter distinction to the ice plant, has, through continual evolution, emerged finally as a successful and economical appliance.

Probably there has been no question put to the electrical dealer oftener than "Can I get a small ice machine for my own?" The field for such an appliance compares in magnitude with the telephone, light, heat and other utilities. As the substitution for ice in the home means a small, compact, automatically operated machine, electricity is the only means by which this may be accomplished, as no other motive power is feasible. The electric domestic refrigerator is in a class by itself because of its ability to accomplish for the household certain things impossible through the use of ice, namely: a much lower temperature in the ice box than can possibly be attained by ice. The melting of ice creates a humid atmosphere, through which the flavor of one food is imparted to another, with disagreeable results; the run-off from an ice box is foul, unsanitary and bothersome, while, on the contrary, electric refrigeration collects from the air within the box and concentrates upon the cooling coil all moisture, leaving the interior of the box absolutely dry, odorless and sanitary. The preservation of foodstuff is not due so much to cold temperature as it is to constant or unvarying temperature—for example, meat will quickly spoil with a variation of ten degrees, and with the use of ice and its continual replacement, such a variation occurs in the ice box, while the electric refrigerator, through the use of a thermostatic control, maintains a practically even temperature, and thus a saving in food to the household. All of these advantages over ice should be capitalized in favor of electricity, because of the actual greater value.

The electric domestic refrigerator on account of its having to automatically coordinate many constantly changing conditions, such as possible interruption of current supply, interruption to water supply, changes in temperature from night to day, regulation of varying compressor pressures, etc., all in a fool-proof machine which must be depended upon to operate without personal attention, has confronted our engineers with a difficult task, which has gradually been mastered, and there are many of these electric domestic refrigerators on the market today which have gone through all experimental stages and may be relied upon as a safe and economical investment by the householder.

Space will not permit going into full detail here to describe the many electric domestic refrigerators on the market, particularly the different controlling devices, but, in general, the compressor system is the one proving successful. Many successful compressors have been developed, both of the displacement and the rotary types, much study having been given to design for best lubrication, least friction loss and longest life. Practically all of these are directly connected to small, high starting torque standard motors.

While the equipment actually varies in detail and construction, the process is one of compressing a refrigerant gas into a liquid, thus raising its temperature, which is lowered again either by extracting the heat through air radiation or water circulation; after which the expansion of this liquid refrigerant back into a gas absorbs the heat that was taken from it, and a consequent low temperature is produced, thus

*Domestic Refrigeration Sub-committee of Commercial Committee: H C. Rice, chairman; J. F. Pollard, vice-chairman; H. C. Marcus.

drawing heat from the refrigerator box and its contents. The electric refrigerator is in reality a heating appliance, negatively speaking, as it serves the purpose of concentrating or drawing the heat to one point in the system and dispensing with it, thus creating an absence of heat in the system, particularly in the refrigerator chamber.

Many successful refrigerants are used, sulphur dioxide being to date the most adaptable for the small refrigerator.

The usual method is to expand the refrigerant through a coil in the cooling box, absorbing heat directly, although in some cases an intermediary or secondary absorption medium is employed by the use of a brine tank, which serves the purpose of attaining lower temperatures and also effecting heat absorption during intervals when compressors are not running. The electric domestic refrigerator can also make a small quantity of ice, if necessary, this being accomplished through inserting in the cooling chamber a pan of water wherein neat cubes of ice may be frozen.

While the first cost of the electric domestic refrigerator is comparatively high, it is well within the reach of the well-to-do house owner desiring such advantages as only the electric refrigerator can give. It is rapidly becoming popular and destined soon to be sold for a much lower price, due to the keen competition and development brought about by the many manufacturers who have undertaken to place such a machine on the market. Several dealers have established dependable repair service, which will have much to do in fixing the permanency of the electric domestic refrigerator's success by intelligently and promptly handling adjustments.

The high load factor of domestic electric refrigerators and the small size of the installation makes it a business which the power companies should encourage with a view to building up a profitable load which will noticeably aid in flattening out the system load curve.

It is the usual custom to compare the annual revenue produced by different domestic appliances, the one producing the largest revenue being considered the most desirable by the lighting company and the one most worthy of exploitation. The most desirable power customer is the one paying the largest amount per year per kilowatt of demand, and invariably more money and effort is spent to secure the power business having a high load factor. Perhaps, if we would analyze electric household appliances along these lines we could decide more intelligently which ones are the most desirable for the lighting company to exploit.

In the case of the electric range, the lighting company must, as a rule, spend more than $100 for increasing the capacity of meter, service wires and transformer before service can be furnished, while the domestic electric refrigerator requires no additional investment of this character on the part of the company.

Annual Revenue for Kilowatt of Demand for Various Electric Appliances

$0.084 is assumed to be the average lighting rate throughout the United States, and $0.0325 the average cooking rate. The refrigerating machine, owing to its high load factor, is assumed to earn the same rate as the range.

It is apparent from the above date that the domestic refrigerating machine produces more revenue per kilowatt of demand than any domestic appliance served by a lighting company, and should, therefore, receive the favorable attention of the electrical industry and particularly the central stations.

Appliance.	Maximum demand in Watts	Annual kw.-hr. consumption	Equivalent hours use of demand	Annual load factor in per cent of max. demand	Rate	Annual revenue	Annual Revenue per kw. of demand
Washer	300	20	66	0.75%	$.084	$ 1.68	$ 5.60
Grill	500	34	68	0.78	.084	2.85	6.70
Toaster	500	37.5	75	0.85	.084	3.15	6.30
Range	5,000	1,500	300	3.4	.0325	48.75	9.75
Iron	575	67	116	1.3	.084	5.62	9.79
Percolator	400	42	105	1.2	.084	4.03	10.07
Cleaner	170	25	147	1.7	.084	2.10	12.35
Radiator	600	96	160	1.8	.084	8.06	13.43
Fan	40	31	775	8.8	.084	2.60	65.00
Refrigeration	300	864	2,880	33.	.0325	28.08	93.60

Note: The annual kw.-hr. consumption of the appliance (except refrigeration) was obtained from data collected by the Society for Electrical Development.

Progress Toward Inductive Co-ordination

By J. E. Woodbridge*

SINCE the Public Utility Commission of the states of California and Nevada have established general orders regulating the construction and operation of power systems for the mitigation of inductive interference the utilities in those states are not as vitally interested in the preparation of such orders as are utilities in the eastern states, where such orders are now contemplated. The joint work of the National Technical Section with the American Telephone & Telegraph Company, in the preparation of a recommended code of rules, has therefore left the committee of this section in a more or less indifferent but advisory position. This committee has advised the National Committee that the codes of principles and practices as published in the reports of the Joint Committee are not sufficiently definite in that they give no quantitative limits whatever, all rules being limited only by such terms as "adequate," "suitable," "substantial," "due," "proper," "material," "close," "reasonable," "negligible," etc.

The National Committee has agreed to proceed with the formulation of quantitative limits or tolerances to these qualitative provisions.

Aside from this advisory work the interest of the section committee centers largely in the application and interpretation of general order No. 52 of the California State Railroad Commission. The effect of this order on power utilities appears to be misunderstood in other parts of the country—one impression for example having gained ground that no new parallels could be established in California. To counteract such misunderstandings the committee passed a resolution as follows:

> "That all companies in this section report to the General Committee all new parallels or exposures one-half mile or over on lines of 60 kv. or more, and of one mile or over on lines of less than 60 kv., or shorter exposures if of particular interest, and also that they report all Railroad Commission rulings or interpretations relating to parallels on their systems."

General Order No. 2 contains no instructions on the division of cost of remedial measures between power and communication utilities. Since this is the most important unsettled principle of Inductive Co-ordination in the State of California, the committee's proceedings have largely been devoted to discussions of this division in the various classes of cases that arise. On account of the general interest in this phase of the subject the committee has requested the enginering department of the California State Railroad Commission to contribute to the proceedings of the coming convention a discussion of their views on this subject, which has been promised. The committee hopes that this will assist in clearing up the uncertainties and differences of opinion that arise in such cases.

*Inductive Co-ordination Committee: J. E. Woodbridge, chairman; W. L. Baden, L. J. Corbett, P. O. Crawford, C. A. Crawford, V. D. Elliott, G Hager, R H. Halpenny, L. M. Klauber, J. A. Koontz, L. J. Moore, T. W. Snell, R. Wilkins, R. J. C. Wood.

Opportunities for the Central Station in Electric Vehicles

By A. M. Frost and H. E. Sandoval

IN 1921 the Electric Vehicle Bureau of the National Electric Light Association reported that more than 211,000,000 kw-hr. of electricity were required annually to charge the storage batteries used in electric vehicles in the United States. Of this amount 60,000,000 kw-hr. were used in electric street trucks, 25,000,000 in electric industrial trucks, and more than 126,000,000 kw-hr. were used in batteries for electric pleasure cars.

The electric vehicle field is too great to cover in one paper, and as the electric street truck affords the greatest possibility for expansion and immediate returns, this paper will be devoted entirely to this division, with the suggestion that next year's committee devote some time and attention to the electric industrial truck and pleasure car.

There are many reasons why the electrical industry and particularly the central stations should use, endorse and promote the electric motor truck, but the one reason which predominates and is of paramount importance by its very nature is the revenue which may be derived from the sale of current for charging purposes. In New York City and its environs the power sold for this class of business amounts to about 30,000,000 kw-hr. annually, with a revenue of about $1,000,000, and an average rate of better than 3 cents per kw-hr. Chicago ran a close second, with almost the same revenue of a million dollars last year.

In 1922 there were 39,413 commercial trucks registered in the state of California. Estimating that the field for electric trucks is approximately 50 per cent of the total, gives a possible number of 20,000 electric trucks in this state. Using an average consumption of 250 kw-hr. per truck per week, this means a total of 240 million kw-hr. per year.

Calculating the value of this load at an average rate as low as 2 cents per kw-hr. the annual revenue to the central stations of the state will be 4.8 millions of dollars.

Interest in the electric truck for town deliveries is growing rapidly, some of the western fleets appearing in the list under Appendix C.

Many central stations spend much time, effort and money in increasing the number of lamp socket devices on their lines, and they are entirely justified in this as it is good business. However, an electric street truck consumes from 4,000 to 12,000 kw-hr. per year, depending on its size and usage, and a medium-size truck in a year consumes as much energy as 750 vacuum cleaners; 650 washing machines; 200 percolators; 200 toasters; 150 irons or 200 60-watt lamps. Fig. 1 shows the use of these appliances.

Apply your own vehicle charging rate to the above consumption and figure your income per truck. And this is not all for the central station, for all the kw-hr. consumption comes during the night hours and tends to fill up that night valley which is such a "menace" to central station dividends. In fact, where central stations wish to supply charging service or offer special off-peak rates, this load can be practically limited to off-peak hours from 10 p. m. to 6 a. m. The effect of the sale of electricity for battery charging purposes on the central station load curve is clearly shown in Fig. II, which was compiled from actual record in substations in New York.

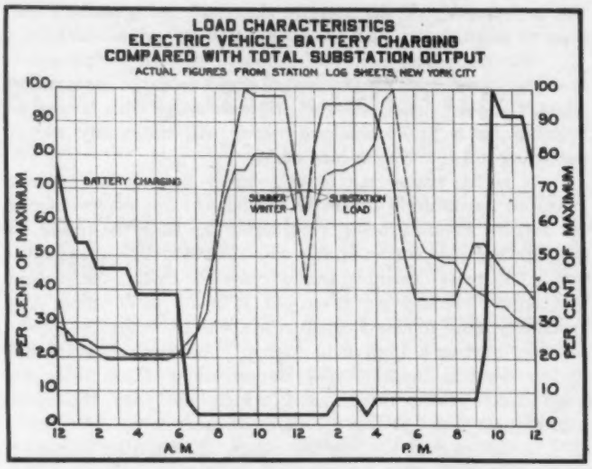

Fig. 2.—The advantages of electric vehicle battery charging as a central station load.

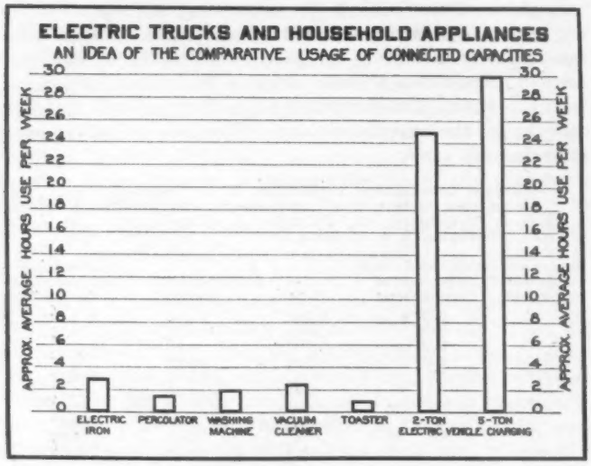

Fig. 1.—Advantages of electric vehicle charging as compared with popular household appliances. Prepared for the Electric Vehicle Bureau of the Commercial Section of the N. E. L. A.—1922.

It is a well recognized fact that the nearer the station's load curve comes to the horizontal the larger will be the earnings of the company involved, and battery charging is a step in that direction.

So much for the central station, but how about the consumer that must buy and operate these energy consuming trucks? As for him, the electric street truck, when used in the proper field, is more economical, more serviceable and more dependable than any other means of transportation, barring none, and this statement is based on facts and figures from actual usage.

And the question naturally follows—what is the proper field of the electric street truck? The electric truck is admirably adapted to the short haul, frequent stop field on heavy traffic city streets, where the total mileage per day does not exceed fifty miles. In this service electric trucking excels all other methods of transportation, and estimates by reputable truck concerns and central stations place from 70 to 85 per cent of all haulage in large cities in this class.

The big industries coming within this field of application are: (1) laundries, (2) bakeries, (3) ice cream manufac-

turers, (4) dairy companies, (5) bottlers, (6) coal and ice dealers, (7) storage warehouses and transfer companies, (8) public utilities, (9) department stores, (10) grocers.

The economy of the electric truck as compared with the horse and gasoline car is due mainly to its slow depreciation and its sane speed; this latter feature not only insuring the slow depreciation, but also materially lowering the general maintenance and operating expense of the vehicle. Tires, for instance, wear out approximately as the square of the speed. Compared with horses in like service, electrics will save from 10 to 35 per cent or more, route for route, while the saving over gas operation has been known to reach 50 per cent or more. Fig. III shows 1,285 10-year-old, 132 15-year-old and 25 21-year-old trucks operating in the Metropolitan District in New York City.

FIG. III.

Electric Trucks in Metropolitan District, January 1st, 1922.

4003—In Service Years	1	395—In Service Years	12
2899— " " "	6	221— " " "	13
2448— " " "	7	156— " " "	14
2044— " " "	8	132— " " "	15
1580— " " "	9	106— " " "	16
1285— " " "	10	74— " " "	17
980— " " "	11	33— " " "	18
		25— " " "	21

Figure the Depreciation

Electric truck depreciation (exclusive of batteries and tires) is figured at 10 per cent, although this would seem to be high. On the other hand, a light gas car wears itself out in two or three years, five years being a maximum average life. Horses seldom stand up in daily service for more than five years. Therefore, figuring depreciation on these at 20 per cent is giving them the best of it.

Fig. IV shows comparative costs for one month test between a 3-ton Electric 8½ years old and a 3½-ton Gas truck 6½ years old, made by Westcott Express Co., in New York City. In neither case are depreciation or drivers' wages included.

FIG. IV.—COMPARATIVE COSTS OF ELECTRIC AND GAS TRUCK.

3½ T Gasoline Truck, 6½ Years Old.

Number of working days (9 hours each)	28 days	
Overtime, 43 hours	4 " —7 hrs.	
Total number days' service	32 days—7 hrs.	
Number pieces baggage handled	3296	
Garaging (estimated)	$ 25.00	
Gasoline cost	154.28	
Oil cost	6.75	
Repairs outside garages	10.00	
Material used	5.91	
Labor	13.43	
Time lost account of breakdowns on street, 5 hours 10 minutes — cost	6.91	
Time lost in garage obtaining equipment, lights, etc., and starting motor, 4 hours 35 minutes—cost	5.25	
Total cost	$226.57	

3 T Electric Truck, 8½ Years Old

Number of working days (9 hours each)	29 days	
Amount of overtime—39 hours	4 " —3 hrs.	
Total number days' service	33 days—3 hrs.	
Number of pieces baggage handled	3294	
Charging and garaging truck (outside garage)	$ 63.00	
Allowance for battery	33.00	
Material used in repairs	2.01	
Labor	7.58	
Time lost for repairs, 40 minutes—cost	.76	
Time lost in garage obtaining equipment, etc., 1 hour 20 minutes — cost	1.53	
Total cost	$107.88	

The wages would doubtless be the same, but the depreciation of the electric would be less if figured in. Figure V shows comparative costs of 17 gas cars and 24 electrics operated by a bakery in Rosedale, Kansas.

FIG. V.—COMPARATIVE COSTS OF OPERATION.

	17 Gas Cars	24 Electric Cars
Gasoline and oil	$ 6,142.50	$ 642.12
Repairs	7,321.44	2,418.80
Tires	4,107.24	963.08
Labor garage	4,046.20	3,560.20
Licenses	248.20	213.37
Depreciation	6,600.00	4,800.00
Current	.....	2,461.50
Insurance	1,802.00	1,950.00
	$30,267.58	$17,009.07

Mr. Cowie, vice-president of the American Express Co., says the cost of operating electric struck versus gas trucks in his experience is in the ratio of 17 to 25, or gas truck costs are nearly 50 per cent greater. Reid, Murdock & Co. of Chicago says "10 electrics cost less for operating expenses than 4 gasoline trucks." Appendix A shows actual comparative costs in detail of gasoline, electric and horse vehicles. Appendix B shows comparative costs of various size gas and electric trucks as prepared by the New York Edison Company.

Any electric truck manufacturer will supply any number of testimonials and data as to the economy of electric trucks from actual usage. Appendix C shows the use of trucks in this territory with testimonials.

Folowing are letters of testimony from truck users in this territory.

GENERAL ELECTRIC COMPANY
San Francisco Office, Rialto Building.

Mr. H. E. Sandoval, Assistant Manager,
Electric Sales Department,
Pacific Gas & Electric Company,
445 Sutter Street,
San Francisco, Calif.

Dear Sir:

In answer to your request that I secure for you information regarding our electric trucks, I am very pleased to attach a copy of a letter addressed by our Mr. H. L. Nagel, Manager of Warehouse, to Mr. E. O. Shreve, our Local Manager.

You may use such figures as you desire from Mr. Nagel's report, which you will notice, however, covers figures up to November, 1920. I might add for your own personal information that none of the figures include depreciation since the investment in these trucks was written off at the end of the fourth year.

If you desire further particulars in connection with this subject I know that Mr. Nagel would be very glad indeed to have you call him direct. I know, however, that these electric trucks have been a splendid investment for us, they are both satisfactory from the standpoint of operation and maintenance and are scarcely ever out of commission on account of necessity for overhauling or repairs.

Yours truly,

(Signed) ALLEN JONES,
Assistant Local Sales Manager.

OLD HOMESTEAD BAKERY
19th & Howard Sts.
San Francisco, Cal., March 29, 1923

Mr. H. E. Sandoval,
Electric Sales Department,
Pacific Gas & Electric Co.,
445 Sutter St., San Francisco, Calif.

Dear Sir:

Agreeable to your request for some comparative data relative to the difference in operating costs between team and electric truck delivery, the writer has looked up the cost of both types of delivery and finds that it costs about $270 a year more to operate an electric truck, than it does to operate a team driven vehicle.

If consideration, however, is given to the additional carrying capacity of electric trucks, their greater speed which permits of serving an additional number of stops and yet completing their trip in from one-half to three-quarters of an hour less time, their greater power which permits of operation up and down steeper hills than a team can negotiate, their ease of operation, their cleanliness and their greater efficiency and dependability, there is actually very little difference in the delivery cost per unit.

From a sanitary standpoint, consideration should also be given to the elimination of the stable, especially around a food manufacturing plant; and from a financial standpoint, the release of tied up capital in land and building therefor.

In addition to these points of superiority, the intangible advertising value reflected in this type of vehicle should not be overlooked. The retail merchant who takes a pride in conducting an up-to-date business appreciates the favorable impression a smart appearing electric truck in front of his establishment creates among his customers, and reciprocates with his trade.

The writer has had ample opportunity to observe the operation of both types of delivery equipment, under varying conditions, and the fact that the institution he represents will be operating a 100% electric truck delivery within the next six months is evidence of his firm belief in their superiority.

Sincerely yours,

(Signed) H. A. BANSHAF.

NATIONAL ICE CREAM COMPANY
Guerrero & 16th Streets.
San Francisco, March 26, 1923.

Pacific Gas & Electric Co.,
445 Sutter Street,
San Francisco.

Attention: Mr. H. E. Sandoval, Electric Sales Department.

Gentlemen:

In response to your recent inquiry relative to electric trucks for San Francisco delivery purposes.

Will state that the Walker Electric trucks we have in our service have given complete satisfaction. Our experience with them began about a year ago and the cost of operation for that year shows considerable

Appendix "A"

Comparative Costs Statement Between Electric Motor Wagons and Gasoline Motor Wagons at Plants "A" and "B"

	PLANT "A"		PLANT "B"	
	Electric Motor Wagons	Gas Motor Wagons	Electric Motor Wagons	Gas Motor Wagons
Labor	$21,776.51	$ 7,536.33	$20,710.32	$10,348.96
Batteries and Supplies	8,734.81	9,217.82	8,369.23	6,504.31
Repairs	14,428.08	16,370.54	19,884.62	9,395.57
Insurance	7,650.00	1,883.06	8,222.16	2,002.72
Taxes	272.53	129.76	322.53	181.84
6% Interest on Investment	14,008.20	3,487.17	14,587.77	3,931.04
Depreciation (Buildings 1%) (Automobiles 10%)	18,664.29	3,549.69	18,680.53	4,412.67
Power (Estimated) (1½c per kw-hr.)	6,739.20	.....	7,300.80	.....
	$92,273.62	$42,174.37	$98,077.96	$36,877.11
Average No. Autos	121	16	130	17
Average No. Routes	101	12	103	10
Average No. Autos per Route	1.198	1.333	1.262	1.700
Average Cost per Route per Year	$913.60	$3,514.53	$952.21	$3,607.71
Investment—Land	$16,736.44	$ 9,439.93	$17,207.54	$ 9,706.77
Buildings	34,017.17	14,948.13	37,287.17	21,022.15
Automobiles	182,716.47	33,731.46	188,632.75	34,788.38
	$233,470.08	$58,119.52	$243,129.46	$65,517.30
Average Investment per Route	$2,310.59	$4,843.29	$2,360.48	$6,551.75

NOTE: In view of the fact that the gasoline routes are twice as long as the electric routes, the true ratio in cost per route per year is 2 to 1 in favor of electrics instead of 4 to 1, as would appear from the figures herewith. The period covered by the above report was over two years.

saving over the cost of gasoline trucks of the same tonnage, capacity and mileage.

We are not in a position right now to quote actual figures but will work this up later on. We have ordered more of them and intend to use them as the need arises in the future.

The 3½-ton capacity trucks we are operating have 6 extra cells which we find adequate for the hills. The average route covered is about sixteen miles, round trip.

Yours very truly,

NATIONAL ICE CREAM CO.,
By (Signed) A. M. DODGE.

AMERICAN RAILWAY EXPRESS CO.
Western Departments,
635-637 Folsom St.,
San Francisco.

March 14, 1923.

Mr. H. E. Sandoval, Sales Engineer,
Electric Sales Department,
Pacific Gas & Electric Co.,
San Francisco, Calif.

Dear Sir:

Confirming our conversation of a few days ago relative to the adaptability of electric street equipment to commercial use in San Francisco:

I have pleasure in advising that in my opinion there is practically as broad a field here as elsewhere for the use of this class of truck. It must be admitted, of course, that its success depends upon a careful study of the specific needs to be covered, but this is true of gas, horse-drawn or any other kind of equipment. The electric truck, provided it is well constructed and placed in a field of operation within its mileage capacity, will and does operate in San Francisco as elsewhere with less upkeep and less general operation cost than do gasoline vehicles.

Trusting that this is the information desired, I am,

Very truly yours,

(Signed) F. R. MAULSBY,
Supt. M. V. Equipment.

THE CALIFORNIA BAKING COMPANY

San Francisco, March 26, 1923.

Pacific Gas & Electric Co.,
445 Sutter Street,
San Francisco.

Attention Mr. Sandoval.

Gentlemen:

We find that electric trucks used for delivery purposes are much cheaper than gasoline trucks.

Our comparative cost reports from a large number of bakeries throughout the country show that the electric cost, on the basis of a hundred pounds of bread, is forty cents while the gasoline trucks used by the same bakeries is seventy cents.

Our costs on both the gasoline and electric cars are less than the average owing to our large volume of business, but the proportions are the same, as our electric costs run between thirty-five and forty cents against sixty to sixty-five cents of the gasoline trucks.

Yours very truly,

THE CALIFORNIA BAKING CO.,
(Signed) R. J. WORKMAN.

PACIFIC STATES ELECTRIC COMPANY

San Francisco, Cal., March 16, 1923.

Pa.cific Gas & Electric Company,
445 Sutter St.,
San Francisco, California.

Attention: Mr. Sandoval, Electric Sales Department.

Gentlemen:

At your request of recent date, I am attaching a report showing the operation of our automobiles for the year 1922 and I hope the figures will be of some value to you in preparing your paper.

Our experience with electric trucks has been very satisfactory particularly from an economic standpoint. Electric trucks are particularly adapted to short heavy hauling and when used for that class of work the cost per mile ton is considerably less than through any other form of transportation.

Unfortunately, at the present time our trucks are not giving the type of service which is normally expected of an electrue truck but that is due to the number of years they have been in operation and the result is that the speed of the trucks has greatly retarded.

Yours very truly,

(Signed) A. H. KAHN,
Purchasing Agent.

Appendix "A"—(Cont.)—Comparative Costs Statement Between Horses at Plants "C," "D," "E," "F," and "G"

	Plant "C"	Plant "D"	Plant "E"	Plant "F"	Plant "G"
Horse Expense	$ 2,668.38	$ 3,608.57	$ 4,106.60	$ 3,984.91	$ 6,912.88
Wagon Expense	2,172.07	3,861.56	5,473.40	501.26	7,287.27
Harness Expense	542.54	720.91	1,504.70	470.20	952.98
Stable Labor	4,168.63	8,443.94	5,916.26	5,892.42	9,783.05
Feed	8,462.45	13,127.41	15,605.33	13,577.72	17,137.78
Stable Sundries	1,049.79	1,873.81	1,889.78	1,176.13	2,444.29
Depreciation (10% on Wagon and Harness) (1%on Land and Buildings)	919.98	1,462.38	1,396.90	1,557.97	1,405.22
Taxes	717.96	868.99	1,512.98	1,613.26	711.00
Insurance	102.26	117.08	120.27	237.07	470.00
6% Interest on Investment	2,772.71	3,926.24	3,661.71	5,768.02	1,692.15
Total Expenses	$23,576.77	$38,010.89	$41,188.93	$34,778.96	$48,796.62
Average No. Wagons	28	32	44	25	75
Average No. Horses	47	80	64	63	96
Average No. Horse Wagon Routes	20	32	32	26	46
Average No. Horses per Route	2.35	2.5	2.	2.423	2.087
Average Cost per Route per Year	$1,178.83	$1,187.84	$1,387.15	$1,337.65	$1,060.80
Average Investment per Route	2,310.60	2,044.92	1,907.14	3,697.65	613.10
Investment:					
Horses, Wagons and Harness	$25,560.89	$24,014.31	$17,628.86	$21,157.99	$27,350.68
Lands and Buildings (Estimated)	20,651.01	41,423.07	43,409.58	74,975.66	851.82
Total Investment	$46,211.90	$65,437.38	$61,038.44	$96,133.65	$28,202.50

The period covered by the above report was over two years.

Appendix "D"—Average Cost on Electric Trucks for Six Months' American Express Co. Boston

	Days in Service	Total Mileage	Electricity	Battery Repairs	Tire Repairs and Renewals	Painting	Body Repairs	Chassis Repairs	Garage Expenses	Total Expenses
1918:										
July	23	438	$9.70	.....	$5.88	$0.74	$4.64	$33.67	$37.50	$92.13
August	23	429	10.43	.....	7.16	.57	4.72	43.64	36.06	102.58
September	23	725	.49	.....	1.79	.56	4.93	30.00	35.30	73.07
October	23	441	22.56	.....	10.21	.77	6.35	25.45	34.36	99.70
November	23	449	.37	.....	7.33	.58	4.46	28.47	36.38	77.50
December	23	460	13.48	.....	11.64	.67	5.79	37.17	42.01	110.76
Average cost 6 months	138	2,942	$57.03	.....	$44.01	$3.89	$30.89	$198.40	$221.61	$555.83
Average cost per month	23	490	$9.50	.....	$7.34	$0.65	$5.15	$33.07	$36.93	$92.64
Cleveland										
July	23	487	$10.11	$11.02	$6.24	.....	$0.96	$29.23	$11.46	$69.02
August	24	500	11.67	19.61	3.69	.....	.34	22.11	13.42	70.84
September	22	486	10.12	10.98	1.09	.58	.23	18.02	17.31	58.33
October	23	495	9.51	17.63	4.37	1.65	6.48	21.54	18.06	79.24
November	21	499	8.90	13.01	6.67	3.35	9.91	29.82	16.21	87.87
December	24	503	10.22	2.08	3.95	2.69	10.59	31.60	9.23	70.33
Average cost 6 months	137	2,970	$60.53	$74.33	$25.98	$8.27	$28.51	$152.32	$85.69	$435.63
Average cost per month	23	495	$10.09	$12.39	$4.33	$1.38	$4.75	$25.39	$14.28	$72.61
Memphis										
July	25	633	$24.09	$4.24	$4.08	.....	$1.84	$3.24	$18.76	$56.25
August	38	677	26.17	8.16	2.04	.....	5.08	2.61	18.76	62.82
September	24	609	24.53	3.44	4.18	$3.13	3.25	2.10	18.76	59.39
October	25	631	26.09	6.32	14.80	2.50	8.98	10.32	18.76	87.77
November	22	550	21.40	19.60	9.94	.....	9.08	2.68	17.50	80.20
December	22	543	20.93	5.32	.....	2.22	11.82	2.31	16.81	59.41
Average cost 6 months	156	3,643	$143.21	$47.08	$35.04	$7.85	$40.05	$23.26	$109.35	$405.84
Average cost per month	26	607	$23.87	$7.85	$5.84	$1.31	$6.67	$3.88	$18.22	$67.64

Were is possible to recharge a battery with the same facility that it is possible to refill a gas tank, the only real handicap of the electric vehicle would be eliminated. For this reason the ultimate goal of battery manufacturers is to build a battery that may be charged or discharged very rapidly, and this is gradually being reached.

An electric vehicle salesman is apt to be called upon to compare his product with the corresponding gasoline vehicle, and when it comes to charging the battery he concedes that this is something a gas car operator does not have to contend with. On the other hand, the driver of a gas car has many duties which are not necessary with the electric, and even the process of supplying energy to the truck is markedly similar in the two cases except for the time involved. Properly designed charging equipment is not more complicated than the equivalent gas pump, nor does it require much more attention. The gasoline pump is equipped with a hose and nozzle, a measuring device and a valve to control the flow. The quantity of gas required is ascertained from the gage on the tank. In the battery charging station, the charging plug and cable take the place of the hose and nozzle. The switch and rheostat control the flow of charging current and an amphere-hour-meter shows the quantity of electricity delivered. The quantity of electricity needed is shown by either the amphere-hour-meter on the vehicle or a hydrometer.

The vehicle salesman is unduly handicapped because the battery is generally accepted as a boxed-in mystery which requires a great deal of care and attention and the charging equipment as something that only an expert can fathom. But is this the case? The average gas car has a starting motor, battery and complete charging equipment which, though similar, is more complex than the corresponding equipment as applied to the electric truck. Yet it is safe to assert that much less attention is paid in the operation of a gas car to the battery, starting motor and charging generator and regulator than to the gas engine, transmission or cluth.

Data on Operating Costs of Gasoline Trucks

Capacity	1,000 Lbs.	1-Ton	2-Ton	3½-Ton	5-Ton
Investment—Chassis	$1,100.00 (Tires $157)	$2,200.00 (Tires $118)	$3,600.00 (Tires $250)	$4,400.00 (Tires $335)	$5,500.00 (Tires $413)
Body	400.00	400.00	500.00	500.00	500.00
Total	$1,500.00	$2,600.00	$4,100.00	$4,900.00	$6,000.00
Fixed Charges:					
Depreciation @ 20% (Less Tires and Body)	$188.60	$402.40	$670.00	$817.00	$1,017.60
Interest @ 6% Half Investment	45.00	78.00	123.00	147.00	180.00
Insurance—Fire and Theft	22.50	29.90	45.10	53.90	66.00
Liability	205.00	205.00	205.00	205.00	205.00
Property Damage	82.00	82.00	82.00	82.00	82.00
Total Fixed Charges	$543.10	$797.30	$1,125.10	$1,304.90	$2,550.00
Operating Charges:					
Garage (Housing, Washing, etc.)	$216.00	$270.00	$300.00	$360.00	$420.00
Gasoline @ 30c per gallon	375.00	450.00	450.00	720.00	900.00
Oil @ 70c per gallon	52.50	52.50	47.60	56.00	84.00
Grease and Waste, etc	30.00	37.50	40.00	45.00	50.00
Tires and Renewal	300.00	450.00	480.00	600.00	742.00
Repairs	250.00	295.00	346.00	500.00	615.00
Driver	1,500.00	1,500.00	1,500.00	1,716.00	1,820.00
Total Operating Charges	$2,723.50	$3,055.00	$3,163.60	$3,997.00	$4,631.00
Total Yearly Costs	$3,266.60	$3,852.30	$4,288.70	$5,301.90	$7,181.60
Cost per day	10.88	12.84	14.29	17.67	23.93
Apparent cost per mile	.21	.25	.35	.44	.59
Speed Miles per Hour	25	30	14	13	14
Miles per gallon, gasoline	12	10	8	5	4
Miles per gallon, oil	200	200	175	150	100
Mileage per day (300-day basis)	50	50	40	40	40
Type of Vehicle	Vim	Vim	Packard	Hulbert	Pierce-Arrow

Simplicity is one of the outstanding features of electric trucks. This should also be charatcteristic of charging equipment. Just as the manufacturers of batteries are striving to simplify the operations involved in caring for the battery, so the designers of charging equipment should simplify its construction and operation. The fundamental requirements for a charging station are: a direct-current source of supply, a switch and rheostat. Additional devices should be furnished sparingly and only when necessary for a special purpose. Simple equipment, with few but rugged protective devices, will usually give better all around satisfaction than a fully automatic board with a number of delicate instruments.

The high cost of the battery and the truck chassis has been frequently listed as a handicap to the general extension of the electric truck field. Especially the chassis and the motor seem to have an extremely high first cost, which cannot be justified in comparison with the cost of gas driven trucks when the more intricate mechanism of the gas trucks is considered in the manufacturing cost.

The maximum of service and dependability from electric trucks comes from (1) its long life, (2) freedom from repair troubles, such as high cost of repairs, time lost, need of reserve equipment, large stock of parts, etc., (3) minimum of supervision, (4) minimum of driver attention, allowing driver to keep clean and solicit new business, (5) simple control, (6) all the speed the law allows in heavy traffic, the control of this speed being inherent in the truck, (7) short turning radius and overall length making it easy to handle in traffic and requiring small garage space, (8) almost instantaneous starting and stopping, (9) no idling when stopped, as with a gas truck, (10) available power for emergencies, (11) low inflammability and hence low insurance, (12) a simple rotating power unit which gives even acceleration and a minimum wear and tear on parts, (13) low tire costs.

Practically all electric truck manufacturers today have more business than ever before. The list of electric truck users includes most of the nationally known concerns which keep accurate account of their transportation costs, and the best testimonial as to the success of the electric truck is that today 70 per cent of the truck manufacturers' business comes from repeat orders. In 1922 the American Railway Express Co. added over 125 street trucks to its fleet, it now totaling 1,284. Appendix D shows the average operating costs of these trucks in Boston, Memphis and Cleveland for a six months' period.

Along with the knowledge of the potential fields and the advantages of the electric truck should go a knowledge of the claims of horse operators and gas car manufacturers. As to the horse, these are (1) lower investment, (2) lower operating cost, (3) a horse's ability to go over a route without supervision. Claim (1) is not true generally where investment in land, stable buildings, feed and other horse equipment is considered. Appendix A shows the average investment per route to be $2,335.53 for electrics and $2,114.64 for horses. Route for route, everything considered, the investment is much the same. Claim (2) is a fallacy for mile-for-mile it costs less to operate an electric than either a gas car or horse-drawn vehicle. Regarding Claim (3) tests show that a route can actually be covered in less time with an electric than with horses.

As to the claims of gas car exponents they are (1) higher speed, (2) unlimited mileage, (3) lower investment. Claim (1) is true, but that this, in itself, will save time on short haul, frequent-stop work does not necessarily follow. To what avail would a 30-mile an hour truck with a 100-mile radius be on an ice wagon route with a 10 or 15-mile haul over a period of ten hours, eight of which were spent standing in streets while ice deliveries are being made? Fig. 6 shows how a slow speed vehicle with a high rate of acceleration would, under conditions of frequent stopping, has about the same or even higher speed as a high-speed vehicle with a low rate of acceleration. In other words, on this work the electric has a high average speed. Actual tests on routes show an electric with a 10-mile speed finishes about the same time as a 25-mile per hour gas car under frequent stop conditions.

Claim (2) is true and electrics should not be recommended over 50 miles per day.

Claim (3) is only true with the cheaper or lower grade cars. The insurance rates for public liability and property damage insurance on electric motor trucks are now 25 per cent lower than corresponding rates for other types of vehicles and the fire insurance savings amount to from 50 to 65 per cent. On a two-ton electric truck these savings taken together amount to $174, which is interest at 6 per cent on

Appendix "C"—Number of Trucks Now in Use in California

Class of Business	Los Angeles		San Francisco		Fresno		Others		Total	
	Less than 2-Ton	2-Ton or More	Less than 2-Ton	2-Ton or More	Less than 2-Ton	2-Ton or More	Less than 2-Ton	2-Ton or More	Less than 2-Ton	2-Ton or More
Bakeries—										
Pacific	28								28	
California			40	2					40	2
Old Homestead			38	1					38	1
Langendorf			1						1	
Golden Sheaf							7		7	
Breweries:										
Eldorado								3		3
Buffalo							1	2	1	2
Coffee, Tea, Coca Cola:										
C-C Co		1								1
Hills			1						1	
Creameries—										
Burr	36	15							36	15
Crescent		8								8
Globe		8								8
Alfred		2								2
Gloria				1						1
Benham						4				4
National				8						8
L. A	102								102	
El Mirador								2		2
Jersey Farm					3				3	
Capital							2		2	
Department Stores—										
Hamburger's	4	2							4	2
Broadway	6								6	
Express—										
American			2	5					2	5
Emmons				1						1
Grain and Milling—										
Globe		4								4
Capital		2								2
Groceries—										
Jevne	4	2							4	2
Craig		1								1
Ice—										
Union		1								1
National				2						2
Peoples						2				2
Ice Dist		4								4
L. A		1								1
Laundries—										
White Star	1								1	
California	1								1	
Hollywood	4								4	
Utilities—										
Bu. P. & L		12								12
City Pasadena								2		2
P. G. & E			1	3			2	1	3	4
P. S. E			1	1					1	1
G. E		1	1	2					1	3
G. W. P			1	1					1	1
S. P				2			1		1	2
W. S. G. & E							2		2	
S. J. L. & P					3	2			3	2
Times Mirror		1								1
Gen. Chemical Co		1								1
Pac. Box Factory				2						2
Bishop & Co		1								1
Bullock's		11								11
Thompson-Diggs							1		1	
Home Service Co	5								5	
James Smith				1						1
							Total		299	128

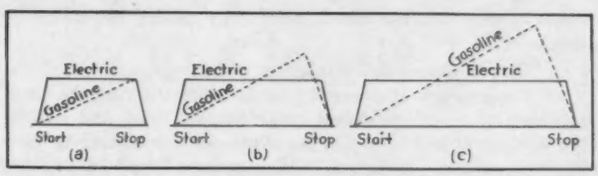

Fig. 6.—Graphical study of accelerations showing how a slow-speed vehicle with a high rate of acceleration would, under conditions of frequent stopping, have about the same or even higher average speed as a high speed vehicle with a low rate of acceleration. Horizontal distances represent time.

a—Both attain the maximum speed of the electric truck. Relative average speeds:— gasoline truck 2.00; electric truck 3.56.

b—The gasoline truck attains 50 per cent higher speed than the electric truck. Relative average speeds:— gasoline truck 3.00; electric truck 3.72.

c—The gasoline truck attains twice the speed of the electric truck. Relative average speed:— gasoline truck 4.00; electric truck 3.80.

$2900, or two-thirds the purchase price of the electric truck. Add to this the increased tire life, longer usefulness and low repair cost and were the owner to get his original gas car for nothing, still he could not afford to operate it in this particular field of service.

Everything being in favor of the electric truck for short haul service, why are not more used? The answer is (1) a lack of accurate knowledge on the part of the user as to delivery or haulage costs, (2) indifference on the part of the electric industry, especially the central station, as to the possibilities of the load. Actual analysis shows that the cost of delivery expressed in percentage of gross income is as follows: bakery 18 to 25 per cent, dairy 20 to 25 per cent, laundry 20 to 30 per cent, ice cream 20 to 25 per cent. A saving of 10 to 50 per cent on these costs means real profits.

Central stations, aside from the savings on operation costs of electric struck in their own trucking, receive a wonderful revenue from this off-peak load. And, indirectly, through the central station the whole electrical industry benefits. Central stations should and must analyze their transportation problems, and where adapted to the service, electric trucks should be used. To attempt electric transportation on long hauls is a bigger mistake at present than to fail to use them in their proper place. The electric truck is entitled to the unqualified support of the electrical industry, which must practice what it preaches. If this is not done, one of the biggest opportunities to obtain increased revenue immediately is slipping through its fingers.

In some localities the central stations may consider it advisable to install charging stations to insure proper servicing of the equipment. The question may even be raised as to whether or not the power company itself must establish these stations. The answer is apparent in the present service stations for starting and lighting batteries on gasoline cars. These stations were installed by the battery manufacturers when the demand became sufficient to warrant them. The central stations' greatest activity should be to sell the idea of electric trucks and to cooperate in every possible way with the truck manufacturer.

Therefore use electric trucks, advertise them and put a salesman out to talk and spread the advantages and economies of electric transportation. Establish a public battery charging station, if possible, although this is not necessary at present. Most of the truck manufacturers maintain men on this coast who will make delivery analysis and cost analysis of transportation problems, and they will recommend electric only where they are adapted to the service and will save money. Some manufacturers will not consider it a sale unless the electric does everything that was claimed for it. What could be fairer? They are doing their part, and now what are you of the electrical industry going to do help this business get started on your systems?

Observations on Operation of Power Transformers

By G. M. Wills*

UNDER the subject of treatment of transformer oil for removal of moisture and foreign substances it appears that one California company has been making use of a centrifugal oil separator with marked success. In the operation of the separator it has been found that the dielectirc strength of oil can be raised from 9,000 volts to 22,000 volts with 0.1 in. gap by passing the oil through the separator once. It is also apparent that the centrifugal type separator is of particular value in the handling of very dirty oil. To quote from the report of this company, "Oil having so much dirt and water in it that it could not be profitably handled with a filter press (for the reason that it would require new blotters every three or four minutes) can be passed through the centrifugal separator at the rate of 150 to 200 gallons per hour. After about 2,000 gallons of such oil have been passed through the

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Appendix "B"—New York Edison Company—Figures on Truck Operation
Data on Operating of Storage Battery Trucks

	1,000 Lbs.	1-Ton	2-Ton	3½-Ton	5-Ton
Capacity					
Investment—Chassis	$1,900.00 (Tires $119)	$2,300.00 (Tires $164)	$2,700.00 (Tires $263)	$3,900.00 (Tires $328)	$4,400.00 (Tires $399)
Battery	690.00	760.00	995.00	1,220.00	1,355.00
Body	400.00	400.00	500.00	500.00	500.00
Total	$2,990.00	$3,460.00	$4,195.00	$5,620.00	$6,255.00
Fixed Charges:					
Depreciation @ 10% (Less Tires and Battery and Body)	$178.00	$213.00	$233.70	$357.20	$400.10
Interest 6% on Half Investment	89.70	103.80	125.85	168.60	187.65
Insurance—Fire	23.00	27.68	33.56	44.96	50.04
Public Liability	205.00	205.00	205.00	205.00	205.00
Property Damage	82.00	82.00	82.00	82.00	82.00
Total Fixed Charges	$577.70	$631.48	$680.11	$857.76	$924.79
Operating Charges:					
Garage (Charging @ 5.6c kw-hr.) (Housing, Washing, Oiling, etc.)	$576.00	$636.00	$696.00	$780.00	$840.00
Battery Renewals (3-year life)	230.00	253.33	331.33	405.00	450.00
Tire Renewals	225.00	262.50	300.00	360.00	480.00
Mechanical Repairs	70.00	105.00	116.85	150.00	170.00
Driver	1,200.00	1,200.00	1,500.00	1,500.00	1,500.00
Total Operating Charges	$2,301.00	$2,456.83	$2,944.18	$3,195.00	$3,440.00
Total Cost per Year	2,878.70	3,088.31	3,624.29	4,052.76	4,364.79
Per Day	9.59	10.29	12.08	13.50	14.54
Apparent Cost per Mile	.18	.20	.30	.33	.36
Miles per Day (300-day basis)	50	50	40	40	40
Total Days	300	300	300	300	300
Speed Loaded	10	9	8	7	6

centrifugal the bowl must be cleaned out. It requires approximately one hour to clean the bowl. We are saving oil—approximately 100 gallons per month—which was formerly thrown away because it was too dirty to filter."

As to the matter of angular displacement for three-phase transformers it does not appear to be of vital importance to the operating companies since reports show that some of them have no preference, although expressions have been received from some companies to the effect that zero displacement should be adopted as standard. The manufacturers are apparently willing to adopt whatever is decided upon by the operating companies as standard.

The value of tertiary windings in transformers connected in Y/Y banks has been well established, but there is still some diversity of opinion as to the proper capacity which should be allowed for in the tertiary winding, assuming that no external load is to be carried by the tertiary winding. Some of the operating companies, in order to insure sufficient capacity, specify that the tertiary windings shall have from 60 per cent to 70 per cent of the rating of the transformers. In one instance the voltage of the tertiary was made of an odd amount so that it could not be conveniently used for any purpose but that of suppressing the third harmonic.

There seems to be a feeling on the part of operating men in general that the manufacturers should give more attention to the standardization of certain parts subject to failure, such, for instance, as the high voltage bushings on transformers and switches. One of the manufacturers has already done considerable work in standardizing on bushings for a certain range of voltage, and it is promised that additional development will be done along this line. There really seems to be no reason why much additional advantage cannot be realized from such standardization since it would do much to reduce the necessary spare parts and should really have some effect toward reduction in cost. The committee suggests that a standard flange and flange drilling for various voltages would be very desirable for the reason that all the manufacturers could then supply their equipment with an arrangement for such flange drilling and in this way allow for interchange of bushings if it became desirable or necessary to do so.

One new development which was reported on was the so-called "Inert Aire" transformer. In this type of transformer, which has been developed by the Westinghouse Electric & Manufacturing Company, the customary air space in the top of the transformer tank above the surface of the oil is filled with nitrogen. A small nitrogen generator is supplied with the transformer to make up for any leakage that may occur, the purpose of the arrangement being to remove oxygen from contact with the oil in the transformer so as to prevent the deleterious effect which is noticeable in transformer oil subjected to high temperatures in the presence of free air.

Installation and Operation of Underground Systems

By E. R. Northmore*

ONE of the important developments this year is the installation of large 35,000-volt sector cable, which is being installed by one of the companies in a separately constructed 8-duct conduit built with a 6-in. water main in the center. This new method of keeping the cable and ducts cool is very interesting and the committee is anxiously waiting to see the completion of this work so that tests can be made to ascertain the benefit derived by cooling the cables by this method.

Changing Methods of Construction

The practice of a number of the companies on the coast has been to install overhead transformers, fuses and switching equipment and then seal the manholes, attempting to keep the ducts and vaults dry and not make an all-lead job in their underground construction, but the companies are gradually changing their method of construction so that all underground work will be all-lead and all transformers, fuses and junction boxes will be absolutely waterproof so that no damage can be done should the manholes and ducts be flooded with water. One of the companies is just completing an all-lead job in the City of Long Beach and has added to this equipment a complete set of underground telephone cables so that its underground department can communicate with its substation from any manhole.

Providing More Duct and Cable Room for Future Use

The committee is of the opinion that in all future underground construction more room should be allowed for additional future capacity; in other words, more ducts should be provided and the manholes should be made as large as possible, for past experience has shown that a large amount of money is spent each year in enlarging present manholes and adding increased duct facilities. The cost of enlarging a manhole with the additional cost of re-racking and cutting over cables is so heavy that it will pay the companies to make ample provision for all future development when the ducts and manholes are first installed. For the last year, in the City of Los Angeles, there has been an average of not less than fifteen manholes or vaults in the course of reconstruction for the purpose of increasing capacity and make room for switches and other apparatus. This constant tearing up of the streets and blocking the traffic is very irritating to the public and places the utility companies in a bad light with the public, who cannot understand why we did not make the necessary provision for our work when we first installed our conduits.

Installing Transformers in Buildings

On account of the large a. c. load in some of the modern fireproof buildings it has been found advantagous to have the owners build transformer rooms in the basements of these buildings. These vaults, ventilated to the outside, are more convenient for the utility companies and at the same time are advantageous to the property owner in that the switching apparatus, fuses, etc., are more accessible, and in an emergency their own engineer can replace fuses and do the necessary switching to insure service which would not be possible if the transformers were located in manholes in the streets.

Standardization of Underground Equipment

The standardization of underground equipment, such as primary fuses, cutouts, junction boxes, etc., is strongly recommended, with particular attention being paid to making this style of equipment as compact and small as possible, for some of the equipment now made for underground construction is so large and bulky that it is almost impossible to install them in the ordinary manhole with the other necessary equipment found in these manholes.

From investigation and tests the committee is of the opinion that the insulation thickness of high voltage cables should be ample to safeguard against cable failures, that it is not considered economic to save on paper and lead while insulation failures of two or three per hundred miles were experienced and that the companies could well afford to pay a little more for the additional insulation.

The special committee appointed last year to investigate cable operating temperatures have not made their final report, but are collecting some very valuable information which will be available shortly.

*Underground Systems Committee: E. R. Northmore, chairman; R. R. Cowles, Vinton Smith, Paul E. Chapman, N. B. Hinson, R. C. Powell, N. D'Oyly, C. A. Heinze, George H. Hager, H. C. Keesling, K. B. Ayres, C. H. Holladay.

Oil Circuit Breaker Development

By H. Michener*

WITH all large companies the circuit breaker problem has become very serious because of the excessive cost of circuit breakers which will interrupt the enormous quantity of energy being fed into a short by the system. These systems are constantly demanding larger and larger switches and more of them.

This problem may be attacked either by increasing the capacities of the circuit breakers or by rearranging the system.

The capacities of the circuit breakers may be increased either by making changes in those already installed or by replacing them with new switches. If it is possible to adequately increase the capacity of those already installed, that would be the preferable way. However, there is very little general information as to what can be done in this way. There have been a few isolated cases in which work of this nature has been done along such lines of replacing the old switch tanks with stronger tanks, giving the switch blades greater travel, installing baffled vents on the switch tanks, and increasing the number of breaks per pole. It would be very desirable, from the operating man's standpoint, if the manufacturers of oil switches would distribute information in regard to what can be done to increase the capacities of their various types of switches.

There are two methods of rearrangement of the system which may be used either jointly or separately, to reduce the duty upon circuit breakers:

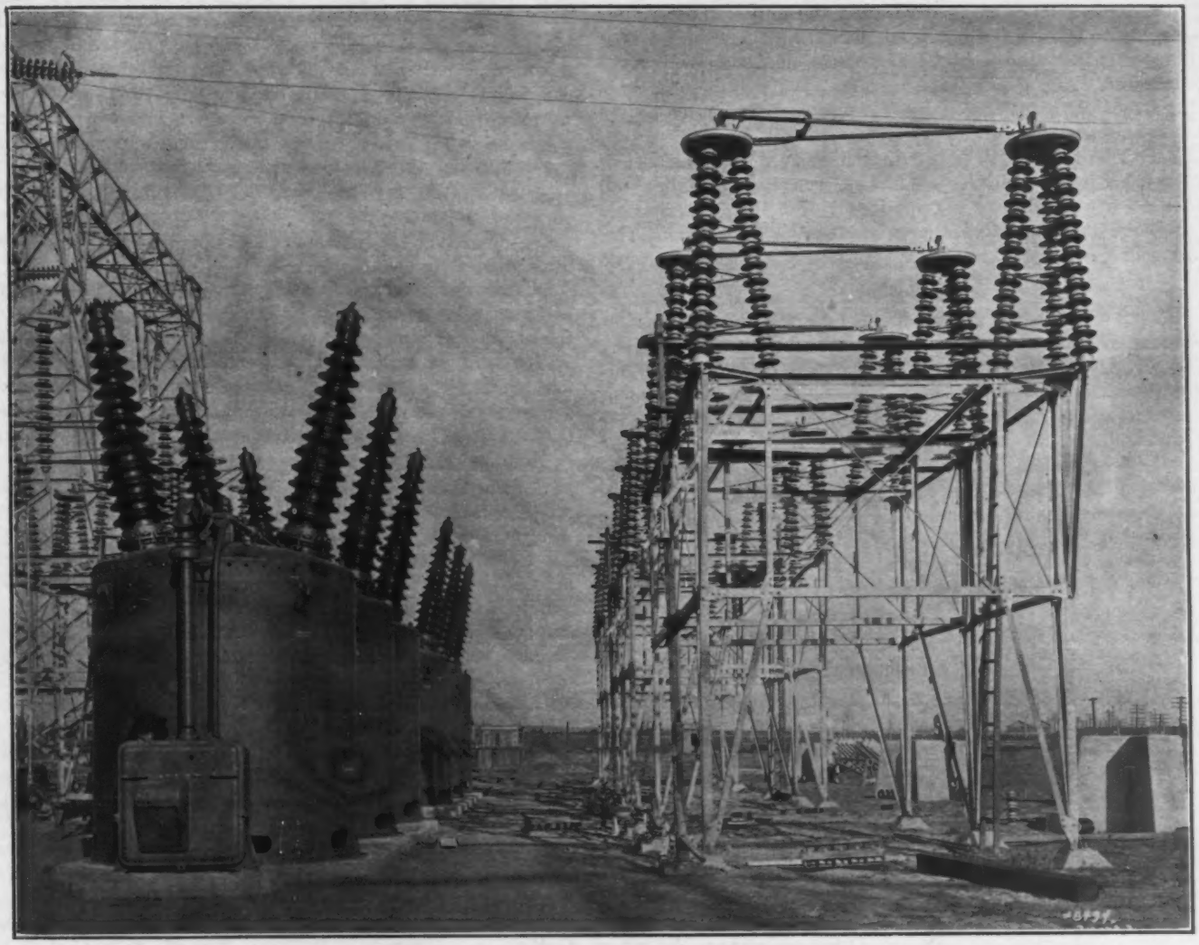
First: The system may be divided into two or more partial systems, each one having its own generation, transmission, distribution and load. These partial systems may be operated as independent systems, except for the shifting of load and generating capacity from one to the other as conditions require, or they may be tied together, each to the adjacent one, by one set of adequate circuit breakers which will open immediately on the occurrence of trouble and thus separate the partial-systems. Then the circuit breaker on the partial-system on which the trouble has occurred will have to open only the short circuit current supplied by the synchronous machines on that partial-system. This method of dividing the systems has not been extensively used but it appears that the larger systems of the Pacific Coast must adopt it within the next few years if they wish to keep the cost of circuit breakers within reason.

Second: The connections in each individual station may be arranged so that a smaller number of circuit breakers will be used. In doing this, care may be exercised to see that some of the troubles due to inadequate arrangement of circuit breakers, which were encountered in the earlier days of the industry, are not forgotten.

Since substation design is not a part of this sub-committee's work, we will follow this subject no farther.

In further reference to the increase of the rupturing capacity of circuit breakers already installed, it should be

*Oil Circuit Sub-Committee of Apparatus Committee: H. Michener, chairman; S. J. Lisberger, F. V. Wright, E. A. Quinn, P. O. Crawford, E. R. Northmore.



Arrangement of 220-kv. oil circuit breakers at Laguna Bell Substation of Southern California Edison Company.

noted that one manufacturer reports that mufflers (baffled vents), when installed on circuit breakers with round tanks, will greatly increase the rupturing capacity but when installed on breakers with rectangular tanks little or no increase in rupturing capacity is obtained because of the weakness of the tank.

These mufflers are arranged so that any oil which is thrown into them will be drained back into the switch tank. The three mufflers, one on each tank of the switch, should be connected to a manifold which should lead to the outside of the building if the switch is installed in a building. This is to prevent the discharge of explosive gases inside the building. This is to prevent the discharge of explosive gases inside the building.

This same manufacturer reports that in some cases an increase in rupturing capacity may be gained by strengthening the connection between the round tank and the cover so that they will not stretch and let oil escape when the circuit breaker opens a short circuit.

Another manufacturer has increased the rupturing capacity of one of his lines of circuit breakers by using a cover of greater strength. These stronger covers can be purchased and placed on switches now in operation.

Carrying Capacity of Circuit Breakers

The carrying capacity of circuit breakers is usually stamped on the name plate by the manufacturer. It often occurs that in buying equipment for a station, the purchasers specify breakers of two capacities—say 100 amp. and 200 amp. The switches are installed. Later the system conditions change so that the circuits connected through the 100-amp. switches carry more than 100 amp. The operator begins to get worried. He probably will recommend that larger switches be installed and his recommendation may be followed. And then it may be discovered that the 100-amp. switches have just the same current carrying parts as the 200-amp. switches.

There seems to be no reason against marking circuit breakers with their actual current carrying capacities (all based upon the same assumptions), even if for mechanical reasons this capacity is greater than that ordered. This practice, if adopted, would save considerable "research" work.

Bushings

It would be very desirable to have the bushings for one make of switch interchangeable with the bushings of any other make of switch for the same voltage classification. This will not be nearly so easy to accomplish as in the case of transformers, for the reason that in most makes of switches the bushings are used to support the stationary parts of the switch contacts. However, the advantage to the operating companies would be so great that it is hoped that the manufacturers will find some way to at least partially obtain this interchangeability.

Compound filled bushings seem to be a thing of the past. Considerable trouble with them has developed during the past three or four years, and they are quite generally abandoned, oil being used where any filling is required.

Accessibility

It is very important to have the contacts of switches easily accessible for inspection and repair. This is accomplished in the small and moderate-sized switches by having the switch elevated on a frame work so that the tanks can be lowered by some type of lifting device which is provided with the switch.

On large switches a manhole is placed in the cover of each tank so that a man can go into the switch after the oil has been removed.

The Westinghouse company has developed a periscope which can be used to inspect the contacts without removing the oil. It is provided with a light to illuminate the parts being inspected.

Interlocking Disconnecting Switches with Circuit Breakers

Year after year the industry drifts along, saying "Ain't it awful" that so much trouble is caused by opening disconnecting switches while they are carrying load? Do we mean it? If so, why do we not find some simple way of interlocking the disconnecting switches with the circuit breakers? This has been done quite simply in in-door low voltage stations where the disconnecting switches are in cells, by interlocking the cell doors with the circuit breakers. Will someone please tell us how to do it in outdoor stations?

Power Required to Operate Circuit Breakers

The operating companies have been quite concerned with the amounts of power required to operate large circuit breakers of recent make. The storage batteries, battery charging sets and control wiring becomes items of considerable expense where large amounts of power are required.

Direct current is generally used for the operation of large switches. Some of the 220-kv. switches recently purchased required from 200 to 250 amp. at from 90 to 125 volts to close them. Others require as high as 500 amp. for closing.

Some 150-kv. switches required approximately 160 amp. to close them.

When switches requiring these heavy closing currents are located considerable distances from the source of d.c. power, the conductors leading to the solenoid must be large to keep the voltage drop within a reasonable limit. It looks rather foolish to see a 300,000 or 400,000-c.m. cable connected to the No. 8 or No. 10 wire of the solenoid, but, nevertheless, it is necessary.

As a source of d.c. power for the operation of circuit breakers, some companies make a general practice of installing storage batteries and battery charging sets, while other companies follow this practice only at substations which have no prime movers and where there are prime movers either steam or water driven control sets with a motor driven set for standby are used instead of storage batteries.

Alternating current control for circuit breakers would be very desirable in many places, especially in automatic stations, but the large amount of power required is a great drawback to its use.

One manufacturer reports that one class of breakers rated as high as 500 amp. at 7,500 volts requires a 5-kva. transformer to supply power for closing; another class rated at 300 amp. at 15,000 volts requires a 10-kva. transformer; and another class rated at 600 amp. at 25,000 volts requires a 15-kva. transformer. The preferable voltage on the solenoid is 440 volts. It is the initial, almost instantaneous, rush of current that determines the size of transformer required.

The Kelman Electric & Manufacturing Company has developed a new 15-kv. single tank oil switch which is somewhat of a departure from the usual trend of development.

This switch is rated at 300 amp. and has six breaks per pole. It is contained in a ¼-in. cylindrical steel tank approximately 3 ft. in diameter and 4 ft. high, with rounded bottom and cast iron cover. The cover carries six 15-kv. bushings, three of which are equipped with bushing type current transformers. This switch is arranged for solenoid operation, air operation with solenoid control of the air valves, or for hand operation. The solenoid operation requires approximately 75 amp. at 100 volts to close the switch. The air operation requires 80 to 100 lb. of air pressure to operate the switch and approximately 10 amp. at 32 volts or 25 amp. at 12 volts to operate the air valves.

The switch is supported from the cover so that the tank may be lowered for inspection and repair of the contacts. Means are provided for attaching two ½-ton chain blocks between the cover and tank for lowering and raising the tank.

Report of the Relay Sub-Committee

By E. R. Stauffacher*

THE work of the Relay Sub-committee has been carried on almost entirely by correspondence, except for the work done at the engineering conclaves at San Francisco in November and at Fresno in March. At the time of the conclave in Los Angeles the sub-committee had not been organized a sufficient length of time to accomplish much work.

In outlining the work of this sub-committee it was felt that it would be well to make a study of the application of relays on the Pacific Coast central stations, and to collect information concerning the use of relays in old stations, as well as in the newer stations, where modern relay protection is provided as an essential feature of the plant design. It was also apparent that it was quite desirable to agree on some uniform method of recording transmission line troubles and the operation of relays in clearing the trouble to the end, that a study could be made of such tabulated data and conclusions reached as to the class of troubles to protect against under Pacific Coast conditions. Such a study should result in the reaching of conclusions as to the effectiveness of various kinds of relay protection and would serve to indicate where relay protection could be applied most effectively.

In line with this program, the work of the sub-committee was classified under the following subjects:

1. What is the practice of the Pacific Coast central stations regarding the installation of modern relays in (a) old stations, (b) new stations under construction, or in the process of design?
2. Are any particular class of relays favored as a general rule, covering all installations, or is each relay application considered on its merits?
3. What is the present practice in regard to differential protection of generators against internal trouble?
4. What is the practice concerning the application of differential protection against internal trouble in large power transformer banks? Can any conclusion be reached regarding the smallest size of transformer which justifies this protection?
5. Bushing type current transformers and their use for the operation of relays.
6. What is the present practice as regards the use of modern induction type relays on feeders operating at 15 kv., 10 kv., 4.0 kv. and 2.2 kv.?
7. Methods of keeping a record of troubles and the action of relays in clearing these troubles. Development of a standard form of record which could be adapted to general use by the Pacific Coast systems.
8. Summarizing the various kinds of trouble experienced on the transmission and distribution lines of Pacific Coast companies to the end that efficient relay protection can be provided. This would also have the result of determining which kind of trouble it is most necessary to protect against.
9. New relay schemes or applications which have developed during the past year.

In summarizing the practice of Pacific Coast companies, your committee would report that the practice of six large companies is as follows:

1—(a). Wherever changes are made and plants and substations are being re-constructed it is the practice of the Pacific Coast companies to replace, as far as possible, the obsolete plunger type relays by modern induction type. Some of the companies have been very active in the change from the old to the newer type of relays, whereas others have only gone to the extent of changing such equipment on the most important incoming and outgoing lines. One company reports changes in approximately forty substations in addition to several generating plants, while another company reports that plans have been perfected and the work is under way to change from plunger type to induction relays in all of the important generating plants and substations throughout its system.

(b). All companies reported that new stations are being equipped with modern protective equipment. This includes a full complement of relays to protect against line troubles, transformer and generator troubles, as well as troubles which might develop in synchronous condensers and frequency changers. To provide the best possible service to consumers it is also the practice to install modern relays in almost all of the outgoing feeders.

2. In regard to what class or type of relay is favored, all are agreed on the induction relay. Under identical conditions, however, some companies favor the current balanced type, where it can possibly be applied, while others prefer the directional type as a general rule. One company reports that it prefers to consider each application as a special case and use the most suitable type of relay obtainable, often changing the relay according to its own ideas.
3. Five of the companies reported that all new generators when installed are equipped with the differential system of protection against internal faults. The specifications for each generator calls for the bringing out of both ends of the generator winding so that the proper current transformers may be readily applied. The current transformer secondaries are so balanced and connected to a low energy relay that the flow of current to ground due to a generator fault will cause the relays to trip the armature and field switches. It is agreed that the differential method of protection offers the best means of preventing extensive damage to the iron laminations and winding of generator or synchronous condenser.
4. Differential protection against internal trouble in large transformer banks is the accepted practice with five companies. Two of the companies use a bank of 3-5,000-kva. transformers as the lower limit at which to apply such protection, while one company makes the lower limit 3-4,000-kva. transformers, and another makes the limit 3-3,700-kva. transformers. Our company applies a special method of protection when two transformer banks are operated in parallel.
5. All companies reported successful use of bushing type current transformers for the operation of relays protecting high tension lines. Care should be taken, however, to calibrate the relay and bushing type current transformer as a unit by means of sending a low voltage current through the primary of the current transformer.
6. All of the companies report that inductive type relays are used on distribution feeders operating at the higher voltages, such as 10 kv., 15 kv. and 33 kv. Only occasional use is made of the induction relay on 4-kv. and 2.3-kv. feeders, where an important power load is fed. However, at these lower voltages the majority of the companies agree that induction type relays should be used
7. There is no uniform method of keeping a record of the interruptions and relay operations amongst the various companies, and it is generally agreed that some uniform report could be used to advantage in making a study of the relay operations. The interruption analysis sheet, as suggested by the Protective Devices Committee of the A. I. E. E., was favorably considered, and it will no doubt be used as a model for future studies of relay operations.
8. An attempt was made to gather a summary of the various kinds of troubles which are experienced during typical conditions during 1922. Three of the companies prepared such a summary and sent it in with their report. It is felt that a summary of troubles, carefully kept for a few years, should give a good basis upon which to determine where relays could be applied to the best advantage.
9. A few of the companies submitted some relay applications which are comparatively new and the wiring diagrams are attached to this report.

   The scheme for the protection of transformers submitted by the San Joaquin Light and Power Corporation has been previously mentioned in the section devoted to differential protection of transformers. Applications of combined overload and residual current directional relays have been submitted by the Pacific Gas and Electric Company—a wiring diagram of which is attached to this report.

   The Southern California Edison Company is applying current balanced relays on its Big Creek 220-kv. lines for the purpose of isolating a section of the line upon the occurrence of a flashover. In addition to this automatic rheostat or flashover suppressors are being installed in the power houses and substations containing synchronous condensers. A detailed explanation, with wiring diagrams illustrating this system, is attached to this report.
10. Two of the large manufacturers of electrical machinery have been very active during the last year in the designing and building of relays for many purposes. The automatic generating plants and substations have created a demand for a number of special relays, in addition to the special relays applied on the various transmission lines. Herewith is submitted a detailed list of relays manufactured by two of the larger manufacturing companies.
11. A universal system of symbols for automatic switches designating the type of relay and connections used would be quite desirable and a set of such symbols is herewith submitted. These symbols are incorporated in the Electric Standards of the Southern California Edison Company.

    The Relay Committee could follow this matter up as a part of its next year's work to the end that some steps may be taken in the universal adoption of standard symbols.

    The relay practice of the San Joaquin Light and Power Corporation is written up in detail and is attached to this report with a diagram and photographs of the testing outfit used on that system.

Protective Equipment for the Control of Flashovers

As a means of isolating the defective section of the Big Creek transmission line at the time of a flashover, use is made

*Relay Sub-committee of Apparatus Committee: E. R. Stauffacher, chairman; C. W. Benham, J. Bridges, R. C. Denny, R. H. Halpenny, O. W. Holden, J. Mini, W. H. Talbott, E. E. Valk.

of induction type relays along the transmission line, as well as automatic trouble rheostats at each of the generating plants and the substation where synchronous condensers are installed.

The protective equipment is divided into two groups:

1st. Induction type balanced relays, so designed and connected that when the two transmission lines are operating in parallel the current in one phase of one of the lines is balanced against the current in the similar phase of the remaining line. These balanced relays are also operated, in some cases, in conjunction with definite minimum inverse time induction type overload relays. When a flashover occurs there is a rush of current to the point of short circuit on the line with a consequent unbalance of the current in the two lines operating in parallel. This current unbalance will cause the relays to function at each end of the particular section of the transmission line in trouble, and the proper oil circuit breakers will be tripped out so that the trouble will not be communiciated to the remaining portion of the system.

2nd. Automatic trouble rheostats with the necessary auxiliary relays and operating mechanism are used to lower the voltage at each of the generating plants at the time of a flashover or transient flow of current to ground. This equipment is intended to come into play when the two transmission lines are operating out of parallel or when one of the sections of either of the lines is out of service for any reason. The characteristics of the transmission line is such that it would be dangerous to sever the transmission line, consequently under the above conditions it is necessary to control a flashover by means of lowering the voltage till the arc is extinguished and then to gradually raise the transmission line voltage to normal.

The detailed application of the protective equipment is as follows:

Balanced Relays:

At Big Creek No. 1: Each of the six 220-kv. to 150-kv. auto tarnsformers which constitute the two banks has a current transformer in the grounded side of the windings. Each of these current transformers is connected to the corresponding phase in the two banks to a suitable induction type balanced current relay. The relays are so connected as to function upon the occurrence of trouble in the line; that is, when current flows to ground and will cause the 150-kv. oil circuit breakers supplying the faulty line to trip out automatically. This will isolate the faulty line. In case any trouble should occur on the second line it will not trip out automatically at this plant and it will be necessary to automatically lower the voltage to clear the trouble.

At Big Creek No. 2: Identical with Big Creek No. 1.

At Big Creek No. 8: Bushing type current transformers are installed in the bushings of the 220-kv. oil circuit breakers. These bushing type current transformers will be connected to induction type balanced relays and the operation will be similar to Big Creek No. 1 and No. 2, in that the first line will be automatic and the second line will be non-automatic.

Big Creek No. 3: The bushing type current transformers in the oil circuit breakers of the incoming lines from Big Creek No. 1, No. 2 and No. 8 are connected to induction type current balanced relays. When trouble occurs these relays will cause the oil circuit breakers feeding the line in trouble to trip out. The remaining lines are automatic by using suitable induction type overload relays.

Vestal Substation: The bushing type current transformers in the grounded side of the auto-transformers are connected to induction type current balanced relays, similar to Big Creek No. 1 and No. 2. The first line in trouble will be cleared automatically, but the second line will be non-automatic.

Magunden Substation: As no auto-transformers are used here the necessary bushing type current transformers are installed in the 220-kv. oil circuit breakers and are connected to induction type current balanced relays, so that the faulty line will be cleared at the time of trouble, leaving the remaining line non-automatic.

Eagle Rock Substation: Induction type current balanced relays are connected to the secondaries of bushing type current transformers, which are connected in the grounded side of the auto-transformers. This connection is the same as the connections at Big Creek No. 2 and No. 1. The first line in trouble will be cleared automatically, leaving the second line non-automatic.

Lagunabell Substation: Induction type power directional or reverse power relays are used in conjunction with definite minimum inverse time induction type overload relays. The necessary connections are made to the secondaries of bushing type current transformers, installed in the bushings of the 220-kv. oil circuit breakers. When current flows from this substation at the time of trouble on the section of the 220-kv. line between Magunden, Eagle Rock and Lagunabell, the faulty line will be cleared at each of these points. Lagunabell also uses the system of isolating the first line in trouble, but keeping the second line non-automatic. It is, therefore, necessary to provide some means (the details of which will be explained later) of controlling the second line under this abnormal condition.

Automatic Trouble Rheostat

The duty of the automatic trouble rheostat is to automatically lower the voltage at the generating stations and substations equipped with synchronous condensers and to automatically lower the machine excitation in case of excess voltage due to cutting a generator free from the transmission system.

The details of the equipment installed to accomplish this are as follows:

At Big Creek No. 1: Low energy induction type relays are so connected in the secondaries of bushing type current transformers, which are installed in the grounded side of the auto-transformer windings so that a flow of ground current, due to a flashover, will cause the relay contacts to close. This will operate auxiliary relays, which in turn will cause a motor to operate which is geared to a suitable auxiliary generator rheostat, known as a trouble rheostat. This will lower the voltage of the generators until the flashover arc breaks and the ground current ceases to flow. The master low energy relay will then open its contacts and the motor geared to the trouble rheostat will then reverse its direction of travel, bringing the generator voltage up to normal. The speed of the motor is such that the generating voltage will be lowered in a period of approximately ten seconds and the voltage is raised from zero voltage to normal voltage in approximately twenty seconds. Therefore, under the worst conditions a flashover should be cleared in a period of one-half of a minute. Provision is also made to open the master switch of the generator voltage regulator at this time, if it is found necessary to lower the voltage at a much more rapid rate of speed.

In addition to the above equipment a suitable curve drawing ammeter is connected in series with the master relay for the purpose of studying the action of the flashover arc, the magniture of the ground current, and the manner in which the trouble was cleared. This ammeter is so designed that the normal chart speed will be three inches per hour, but at the time of a flow of ground current the chart speed will automatically change to three inches per minute. When the flashover breaks the speed will automatically return to normal.

To protect against a rise in generator voltage when, for any reason, the load is suddenly dropped, an induction type voltage relay is installed across the secondary of a potential transformer, which is connected to the generator bus. The relay contacts are connected in parallel with the master relay contacts and thus upon the occurrence of high voltage the trouble rheostat is brought into play until the voltage is lowered to normal.

Big Creek No. 2: The same equipment as used at Big Creek No. 1 is installed.

Big Creek No. 3: The same general scheme of control as Big Creek No. 1 and No. 2 is used, although the details are somewhat different. As this station has no auto-transformers the bushing type current transformers are connected in the 220-kv. transformer neutrals.

Big Creek No. 2: The same equipment as used at Big Creek No. 1 and No. 2 is used.

Vestal Substation: At this substation the equipment for lowering the exciter voltage of the 50-cycle to 60-cycle 15,000-kva. frequency changer is practically identical with that used at Big Creek No. 1, No. 2 and No. 3.

Eagle Rock Substation: The master switch relay is connected in the secondaries of the bushing type current transformers used in the auto-transformer neutrals. When the relay contacts close, due to a transient flow of current to ground, the master switch of the Terrill regulators controlling the three synchronous condensers is opened. This will allow the machines to operate as induction motors until the trouble is cleared. The Terrill regulators are then manually restored to service.

Lagunabell Substation: The general scheme of controlling the synchronous condenser at this substation is the same as used at Eagle Rock. The relays are different in their details and connections are made to the secondaries or bushing type current transformers which are in the neutrals of the 220-kv. transformers. As this station was originally designed for 220-kv. operation, there is no need of 220-kv. to 150-kv. auto-transformers, as is the case at Eagle Rock.

***SUMMARY OF INTERRUPTION**

	CAUSES	VOLTAGE 10 Kv.	15 Kv.	30 Kv.	60 Kv.	110 Kv.	150 Kv.	Total
1	Unknown	73	18	7	32			130
2	Insulator Failure	18	8	6	31			63
3	Mistake in Switching	4	3					7
4	Trees in Line	5	2					7
5	Pole Burned	3	2		1			6
6	Lightning and Flashovers				1		3	4
7	Birds, etc., Getting in Line				9			9
8	Brush Fires				1			1
9	Pole Broken	2	2		1			5
10	Oil Switch Failure	6	4		1			11
11	Failure of Other Apparatus	6	12	7	1			26
12	Line Wires Blown Together		1					1
13	Pole Blown Over		3		2			5
14	Accidents	9	2		3			14
15	Arrester Trouble	1						1
16	Bushing Failure		1					1
17	Line Failure		1	3	1	1		6
18	Trouble on Other Lines	6	15		2			22
	Total,	132	74	23	86	1	3	319

*2 Months' Operation of 3 Companies during 1922.

Conclusion: In the majority of flashovers there will be no occasion for the automatic trouble rheostats to come into action, as the current balanced relays will clear the trouble immediately. The trouble rheostat will only have occasion to function when the 220-kv. lines are operating out of parallel or when, for any reason, one of the lines is out of service. At present the 220-kv. line is divided into three main sections, but it is planned to ultimately divide the line into six sections, each of which will be approximately forty miles long.

Relay Practice—San Joaquin Light & Power Corporation

It is the practice of the San Joaquin Light & Power Corporation to make a test on all overload and power directional relays whenever possible by means of applying a known test current through the switch and current transformer and measuring the current in the secondary of the current transformer, the tripping time of the switch and also the "mechanical time" of the switch. By "mechanical time" is meant the time measured from the closing of the relay contacts to the actual opening of the switch contacts. When testing power directional relays the directional contacts are blocked closed and the relay tested for time. Then the directional contacts are unblocked and this feature is checked by noting position of directional disk for a known direction of flow of power.

The outfit used for setting relays on the San Joaquin Light & Power Corporation's system is mounted on a small trailer which is hauled to the point where test is to be made by the substation inspector. It can very easily be moved to a point near the switch or other piece equipment to be tested by hand after arrival at the substation or power house.

The testing outfit itself, consists of a 2-kw. Westinghouse sign lighting transformer with a 220-volt primary winding and a 10-volt or 20-volt secondary. There are two carbon disk rheostats in the primary circuit, one of 4—500-watt units and the second of 1—250-watt unit. These are normally all connected in series. For high current values the 4 units of the first rheostat can be connected in parallel and the second rheostat short circuited. There is a 2 to 1 potential transformer connected across the supply circuit to obtain 110 volts for the cycle counter. The range of this equipment is from about 10 amp. to 400 amp. The lower values are obtained by applying 110 volts to the primary of the testing transformer.

The instruments used with this equipment are a portable voltmeter of 600-volt range, a low reading voltmeter with 1.5 and 15-volt scale, ammeters to give accurate readings from 5 to 300 amp. and a 500 to 5 current transformer for higher readings. All time readings are obtained by means of a cycle counter. Phase rotation is obtained when necessary by means of a phase sequence indicator.

It has been found very convenient to measure the resistance of switch contacts by means of the low reading voltmeter while making tests of relay and switch operation. This gives the tester an idea of the condition of the blade contact and takes hardly any additional time.

The above described equipment has proven very convenient and satisfactory but is hardly of great enough capacity for an adequate test of inverse time relays. This company has ordered a small regulator and General Electric type M transformer which will be capable of supplying up to 1,000 amp. The addition of a current transformer of like capacity will complete the outfit.

It has been found necessary to make a very careful check of the connections in each new installation of directional overload relays to insure proper operation. This test is made by a representative of the meter department.

The standard arrangement at each substation is as follows: The 60-kv. bus is connected through an oil circuit breaker at either end to the incoming and outgoing lines. Each of these circuit breakers is equipped with bushing type current transformers which are connected to single-phase directional overload relays.

The station bank is connected star-star. On the low side is connected a potential bank which is also connected star-star. Half taps are brought out in the low tension winding of the potential bank and the directional elements of the relays are supplied from the proper pair to give a potential which lags 30° behind the corresponding phase potential.

In wiring the bushing type current transformers, conductors with different colored braids are used so that they can be readily traced through the conduit. The same scheme is applied in the potential wiring.

To determine the phase sequence the phase sequence indicator supplied by the States Company has been used. This piece of apparatus has proven very satisfactory. Occasionally use has been made of a device similar to that described by Mr. Varley in an article in the Electrical World several years ago. This device consists of two lamps and a reactance.

After ascertaining the proper potential to combine with each of the phase currents, arrangements are made with the system dispatcher so that power may be transmitted by the station in a definite direction. This permits a check on the directional elements and the permanent connections are made so that the relays will give operations for the prescribed direction.

The maintenance testing is handled by the substation inspection crews on the San Joaquin system. An inspection is made of each substation at least once a month and the more important suggestions receive two inspections per month. The inspectors work directly under the division electrical superintendent and receive their instructions regarding tests to be made from his office. The desired information regarding time and current settings for all transmission line switches and transformer switches that are equipped with relays is given to the division electrical superintendent by the operating engineer of the company by means of a relay test tag. When the relay setting called for is made, the relay test tag is filled out in duplicate, one copy being retained in the division electrical superintendent's files and the other forwarded through the road dispatcher to the operating engineer.

The load dispatcher's office is notified by the inspector that he is ready to make a maintenance test of a switch and if operating conditions make it possible the switch is taken out of service long enough for him to thoroughly test the action of the relay and switch. This is usually possible in the case of transmission switches on the San Joaquin system owing to their loop system which allows of the "killing" of a section of line between two substations without dropping any load, or to their practice of installing "bypasses" around transmission switches and transfer buses for distribution switches. When the inspector obtains his clearance on the desired switch he trips the switch several times and carefully notes the action of the relay, trip coil and switch mechanism. He examines all wiring for loose or faulty contacts and carefully looks over the relays for mechanical defects. If any are found he either repairs them or gets a spare relay and installs it and returns the defective one to the meter department for repair. He is particularly careful to see that all contacts within the relay are clean and in good condition. If the relay is of the bellows type he sees that the leather is flexible, using a very little neats foot oil if necessary. In the case of power directional relays he checks them for proper directional setting by learning from the load dispatcher the direction of flow of power after he has cleared on the switch under test and it has been put back in service. If, owing to conditions of load or trouble it is not possible to get the switch to be tested out of service,

the inspector "blocks" the mechanism of the switch mechanically and tries out the relays.

The principal items of trouble with induction type relays are dust or corrosion of contacts of relay or auxiliary contactor switch, burning out of auxiliary contactor switch coil due to failure of pallet switch to open trip circuit and the loosening of a bearing so that disk drags on the magnets.

With bellows type relays the time is quite variable due to change in the flexibility of the leather. In the circuit opening type where they are subjected to heavy current values the contacts sometimes burn "closed" thus making the relay inoperative. In the circuit closing type the contacts sometimes stick closed. This can usually be obviated by the use of the quick return valve attachment.

In addition to the above maintenance test of relays a complete overall test of the action of relays and switches is made by means of the relay testing equipment at least once every six months. In this test a known current is applied through the switch and current transformer and readings of secondary current and of tripping time are noted for each relay.

Also the mechanical time of the switch is noted and any readjustments or repairs are made that are found advisable and the switch retested. This work is done by the chief substation inspector and time curves are plotted for the switch in terms of current through the switch. These curves are filed in the division superintendent's office. A record of each switch is also kept which shows date that any repairs or readjustments were made, what they consisted of and who was in charge of the work.

Uniform Classification of Accounts

By C. P. Staal*

DURING the fiscal year ending June 30, 1923, the efforts of the accounting committee were directed principally to the making of new classification of accounts. The immediate necessity for a change in classification for California arose from the fact that the Federal Power Commission, in accordance with provisions of the Federal Water Power Act, had, during the latter part of 1921 and the early part of 1922, taken definite steps looking to the adoption of a classification of accounts to provide the necessary accounting procedure for the proper administration of the act.

Inasmuch as most of the larger companies had at this time, or probably would in the near future, become subject to the rules and regulations of the Federal Power Commission as a result of taking out licenses under the Federal Water Power Act for a part of their properties previously constructed, or for new projects to be constructed, the subjest of uniformity in accounting as between the state regulating authority and the Federal Power Commission became a question of vital importance to those of us who are interested in that branch of the business.

The members of the California Railroad Commission staff particularly interested in accounting matters were among the first to clearly foresee the desirability of prompt action to insure complete harmony, and accordingly made known their intention of making a revision to meet the situation if, and when, the Federal Power Commission adopted its classification of accounts.

Concurrently, at this stage of the activities along these lines the Chief Accountant of the Federal Power Commission had attempted, through various ways and means, meetings formal and otherwise, to reach an agreement with the National Electric Light Association. At a time when there seemed to be some difficulty in accomplishing his purpose, he made a visit to the Pacific Coast, which afforded an opportunity for personal interchange of ideas between him and the operating companies.

At the conferences which were had during his visit efforts were made to coordinate as far as possible accounting requirements and practices under actual operating conditions and rate regulations, with the purposes and intentions of the Federal Power Commission in carrying out its requirements under the act.

The attitude of the Federal Power Commission was found to be distinctly along the lines of meeting the practical need of the business, and the desirability of uniformity in state and federal accounting procedure seemed to be fully realized.

With this situation as set forth above as a background or starting point for the year's work the accounting committee realized that in all probability these very important problems would be disposed of during the fiscal year. The responsibility of the committee was clearly to direct its efforts toward the building up of a classification of accounts for the state which would meet our requirements and conditions to the best possible advantage.

Five meetings were held during the year, four of which were devoted to the classification. Aside from this a great deal of time was given to this subject by several members of the committee who represented the larger companies in the state.

In all of our activities we had worked in very close contact with the members of the California Railroad Commission staff, who had this work in hand, and there has at all times been cooperation to the fullest extent.

On Sept. 18, 1922, the Federal Power Commission called a meeting for the purpose of affording opportunity for discussing a classification proposed by that commission for formal adoption, and, to represent the companies operating in the state, four companies were invited to send their auditors to this meeting. These companies were: Pacific Gas & Electric Company, San Francisco, E. W. Hodges, auditor; San Joaquin Light & Power Corporation, Fresno, A. B. Carpenter, auditor; Southern Sierras Power Company, Riverside, P. R. Ferguson, auditor, and Southern California Edison Company, Los Angeles, C. P. Staal, auditor.

The four representatives were in attendance as representatives of their respective companies and not as representatives of this association. In addition, W. C. Fankhauser, of the California Railroad Commission, attended. There were also in attendance representatives of numerous eastern companies, the committee on uniform classification of accounts of the National Electric Light Association, the Accounting Committee of the National Association of Railway and Utilities Commissioners and Carl D. Jackson, president of the latter association.

After a brief formal hearing before O. C. Merrill, executive secretary of the Federal Power Commission, during the forenoon of Sept. 18, a committee, appointed by Mr. Merrill, undertook an informal discussion of the subject, these meetings being continued daily until Sept. 27.

Mr. Merrill appointed the committee to consist of all of those present at the formal meeting who wished to attend

*Accounting Committee: C. P. Staal, chairman; A. B. Carpenter, vice-chairman; P. R. Ferguson, E. W. Hodges, L. A. Reynolds, A. C. Reynolds, P. A. Bailey, W E. Houghton.

the committee meeting. As a result of this appointment by Mr. Merrill the personnel of the committee was the two committees referred to above, the four representatives of the California companies, W. C. Fankhauser of the California Commission, and Carl D. Jackson, who acted as special representative of counsel for the two committees. The Federal Power Commission was represented by Wm. V. King, chief accountant, and his assistant, Mr. Friede. The premise from which the reason for and the beginning of the meeting sprang seemed to be that there should be uniformity in accounting as between the requirements of the State and the Federal Power Commission. There appeared to be no difference of opinion as to this point.

However, the views of the members of the committee seemed to differ to such an extent that it appeared uncertain at the outset as to whether or not a common ground or basis could be found from which the subject could be discussed or even approached. The question at issue was as to whether the tentative draft of the Federal Power Commission or the classification of the National Association of Railway and Utilities Commissioners should form the basis for the discussion.

The discussion was finally carried forward, using the Federal Power Commission's tentative draft as the basis.

The classification which resulted and which was finally adopted by the Federal Power Commission is in reality a combination of many compromises and changes made in a sincere desire to have uniformity with all of the states, and some of us had even dared to hope that all of the changes and compromises worked out and apparently agreed upon at this conference would be embodied in the classification later adopted by the National Association of Railway and Utilities Commissioners and approved by the National Electric Light Association. In this, however, we were disappointed.

Following closely upon the adoption by the Federal Power Commission of its classification, the California Railroad Commission called a hearing on Dec. 4, 1922, in the matter of adopting a classification to become effective Jan. 1, 1923.

The classification was drawn parallel to that of the Federal Power Commission and in due course was formally adopted on Dec. 13, 1923.

The members of this committee feel highly elated over the consummation in this very satisfactory manner of this important matter and believe that something of inestimable value has been accomplished which permits of our accounting being done in the same manner for both the California Railroad Commission and the Federal Power Commission.

The fifth meeting of the committee was devoted to formulating a recommendation to the California Railroad Commission for permission to treat Accounts 390 to 395 inclusive—"Overhead Construction Costs," as clearing accounts, distributing the entire amount of charges against these accounts to the other fixed capital accounts to which they were properly related. This recommendation has been referred to J. B. Black, president of the association, for presentation in such manner as he may consider proper.

The attention of the committee having been taken up entirely with these important matters, no sub-committees were formed and none of the other activities included within the scope of the Accounting Committee were undertaken.

Effects of Various Colored Cases on the Oil Temperature of Distribution Transformers

By E. J. Moore and J. H. Moulton

A LACK of information as to the effect on the internal temperatures of transformers produced by using various colored paints on the cases led the San Joaquin Light and Power Corporation to make a series of such tests during August and September, 1922. In making these tests the endeavor was made to duplicate operating conditions in every way. Accordingly, the structure shown in the attached photograph was erected in the yard of the Fresno O Street Substation.

The poles were placed in a north and south line, exposing the transformers to the direct rays of the sun, except for a few minutes at noon, when the shadow of the southerly pole swept across the structure. Two 6-in. x 8-in. crossarms were bolted to the poles approximately 20 ft. above ground on which were placed four 3-kva. 6,900/220/110-volt transformers for test purposes, together with the necessary recording transformers, and two 2-kva. 2,400/220/110-volt transformers to supply the impedance voltage in the full load runs.

Purposes of the Test

The tests were made with the following purposes in view:

1. To obtain the effect on the oil temperature of transformers under no load and not excited, which various colored paints applied to the exterior of the cases would have.

2. To obtain similar information as to the oil temperatures when the transformers were excited at normal voltage, but with no other load on the windings.

3. To obtain similar information with the transformer windings subjected to full load.

4. To obtain the inherent differences of oil temperature due to variations in construction, eliminating, by painting the cases of all transformers black, all effect of case color.

Tests 1 and 2 were made as a check on certain laboratory experiments which tended to show that the color of the transformer case had a greater effect on the oil temperature at no load than at full load.

For Tests 1, 2 and 3, as outlined above, the cases were painted as follows:

Transformer A.—Black.
" B.—Dark Gray.
" C.—Westinghouse Standard Gray.
" D.—Light Gray.

For Test 4, the cases of the four transformers were given two coats of black paint, which was allowed to dry thoroughly and which produced identical surface characteristics on the four transformers.

Two holes were drilled in the cover of each transformer. The lead of a recording thermometer was passed through one of the holes and the bulb located in the oil immediately above the windings. A calibrated mercury thermometer was placed in the other hole with the bulb in a similar position.

Table 1 was compiled from the detail results of the various tests and shows the maximum temperatures recorded each day.

TABLE I.—TRANSFORMER TEMPERATURE RUNS.
Daily Maximum Oil Temperature Recorded

			NORMAL FULL LOAD Temperature Degrees Fahrenheit			
			A, Case	B Case	C Case	D Case
Date	Time P.M.	Ambient	Black	Dk. Gray	Med. Gray	Lt. Gray
8-24-22	3:30	89	136.4	132.8	138.2	132.2
8-25-22	4:05	95	143.2	142.2	145.8	142.0
8-29-22	4:40	96	141.7	138.4	143.8	140.0
8-30-22	4:55	89	134.8	131.6	136.8	132.0
9- 1-88	5:35	94	145.9	142.6	146.5	141.9
9-18-22	4:00	100	141.5	140.0	142.7	140.0
9-19-22	5:00	102	154.6	.....	153.4	150.0
9-20-22	4:00	99	145.3	141.5	144.6	141.7

Conclusions

A study of Test 4, with all cases black, shows that the characteristics of the four transformers as to their oil temperature vary somewhat. It is seen, however, that during the maximum temperature periods of each day the same relative differences in temperature are maintained. Considering transformer A as the standard of comparison, the following differences in the oil temperatures of the other transformers are noted:

Transformer A.—Zero degrees F.
" B.—Plus 2 degrees F.
" C.—Minus 1.2 degrees F.
" D.—Zero degrees F.

In other words, this is the correction which, if applied to the observed temperature of the transformers when the cases were painted black, would give the same temperature for all four. It, therefore, appears that this same correction should be applied to the observed temperatures of each transformer when the cases were painted various colors before a comparison was made as to the effect of the various colors. It should be noted particularly that this correction has not been applied in compiling Table No. 1, but will be applied to values taken from this table in interpreting the tests.

Test 1 shows that during the maximum temperature period of each day there is a difference in temperature after the correction factors shown immediately above are applied, as follows:

Between transformers A and C.—C is 4 to 5° lower.
" " A and D.—D is 8 to 12° lower.

Test 2 shows a corrected difference in the oil temperatures of the various transformers during the maximum temperature period as follows:

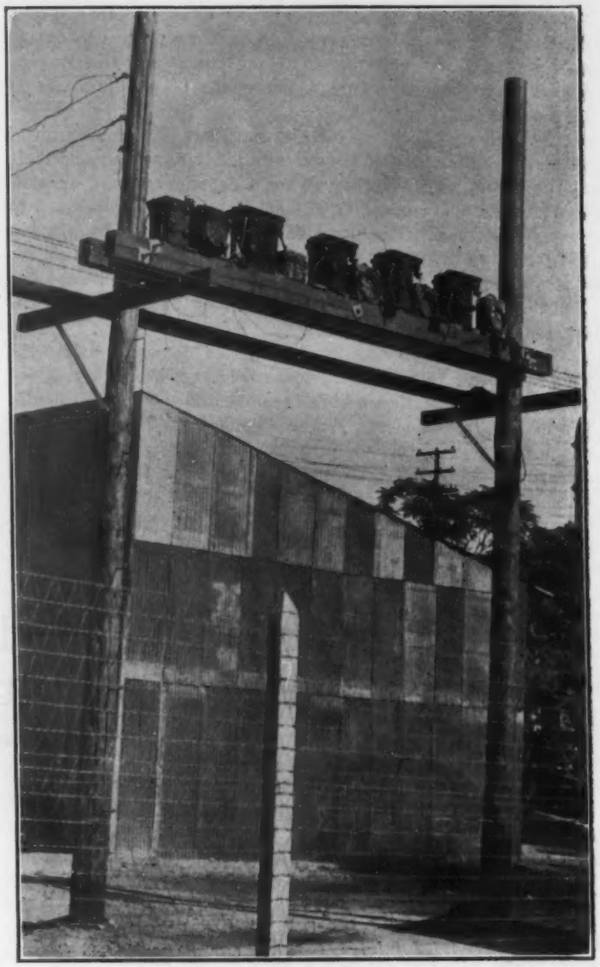
Between A and B.—No difference.
" A and C.—No difference.
" A and D.—3 to 4 degrees.

Test 3 for the transformers operating at full load shows the following corrected differences during the maximum temperature periods:

Between A and B.—B is 1 to 2 degrees lower.
" A and C.—C is 0 to 1½ degrees lower.
" A and D.—D is 2 to 4 degrees lower.

The number of successive days during which tests were made and the consistency of the results leaves little doubt as to the accuracy of the full load tests. The fact that a gray paint will not reduce the oil temperature more than 3 or 4 degrees F. or 1 or 2 degrees C. during the extremely hot weather encountered in the San Joaquin Valley seems established. This was a disappointment in view of the seemingly prevalent belief that a much larger reduction for gray paint would be found.

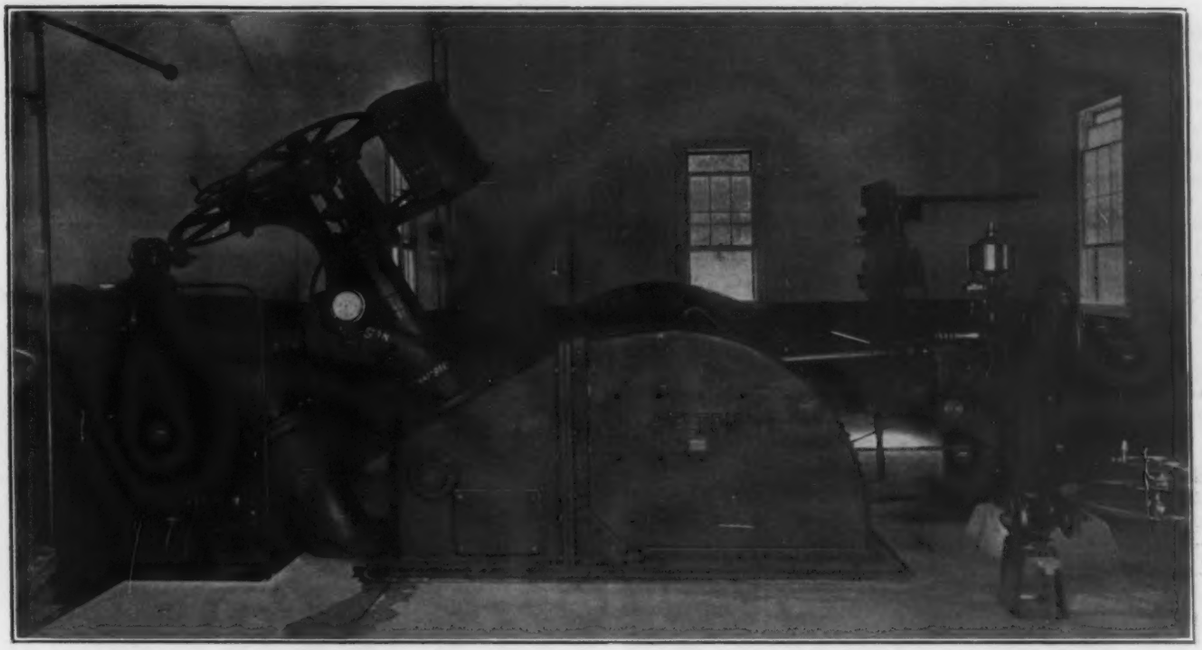
It is interesting to note that apparently when the transformers are absorbing heat, as they are during Test 1, the color appears to have an appreciable bearing on the oil temperature. It was found, however, that the transformers maintain the same relative position during all portions of this run.



Structure erected by San Joaquin Light & Power Corporation to test effect of various colored cases on oil temperature of distribution transformers under service conditions

It was expected that the black transformer which absorbed heat more rapidly during the day, and was consequently hotter at this time, would radiate the heat better at night, and consequently run cooler than the gray transformers.

We have reached the conclusion, after a very careful study of the results herein recorded, that any additional expenditure to procure a gray case in place of black would not be justified. This is in view of the fact that the differences in temperature do not under full load conditions vary any more than the differences obtained from various makes operating under identical conditions. Assuming that gray or black tanks are available at equal cost, and that experience shows that the gray paint stands up in service as satisfactorily as the black, we would be inclined to favor the medium gray tank. We feel very strongly, however, that any expenditure to repaint black cases now in service would not in any way be justified.



Interior view of power house No. 2 of the Ontario Power Company. This plant has been in operation since October, 1919.

Economies Effected by Installation of Automatic Generating Plants

By R. C. Denny*

AMONG the several companies of the Pacific Coast Electrical Association using automatic generating plants, the underlying reasons for such installations are in most cases largely the same. Usually it is a case of changing over small pioneer plants that exist on every system or those bought up in the course of a system's expansion. In their day, when the kilowatt-hour sold for more, their operation was no doubt economical, however, the large, modern plant of the present day has made conspicuous the rather uneconomical operation of these small plants. To make any good showing at all in competition with the large plant the small plants must necessarily be made over to operate, either entirely automatically or by remote control, from a more important station, and thereby eliminate the attendance expense. It is more often the case, however, that owing to the necessity of keeping one man on the property as a watchman or caretaker, the plant is found operating semi-automatically under normal conditions and requiring a certain amount of personal supervision under abnormal conditions. Thus semi-automatic operation minimizes the attendance expense and make possible the economic operation of such plants.

The personnel problem is another consideration having an important bearing on the situation. In the present day, power plant operators, while not organized as a particular body, are assuming an independent attitude toward their employers and an air of indifference toward their work. In the camps they expect the modern conveniences of the city, and even when given the best accommodations rarely show any appreciation. Their jobs are simply a means to a salary, and there their interest ends. Among professional operators the man who shows the loyalty to his company and the interest in his work necessary to advance him to better positions is exceedingly rare. They are constantly moving from one system to another, staying just long enough to inconvenience their employer when they leave, which is usually on rather short notice. It is no small wonder, then, having this condition to contend with, particularly in small, remote plants, we find automatic apparatus coming into use to replace uncertain or unreliable labor.

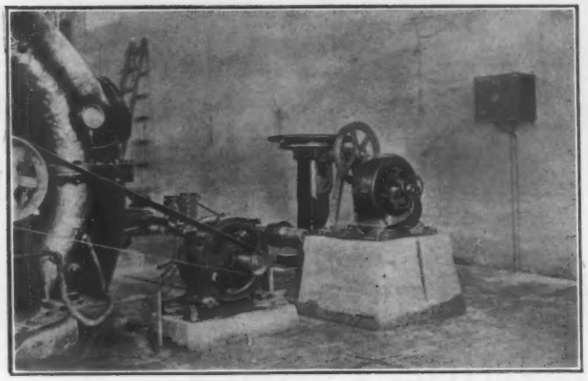
There has been in the P. C. E. A. several instances of entirely new developments of small water powers in automatic installations, where low head possibilities had not been utilized owing to high production costs under the old scheme of operation. These developments have been based largely on the successful application of automatic apparatus in old plants and the consequent good results obtained therefrom. The confidence gained through actual results obtained will doubtless lead to many entirely new automatic plant developments.

On the systems of the three member companies who are actually pursuing this practice in small generating plants there are some fifteen automatic or semi-automatic installations in actual use and several others either under construction or planned. Some of these plants in their operation are fulfilling other purposes than merely that of adding kilowatt-hours to their systems' output. They may be regulating the flow of stored water to other more important plants below or to irrigation districts, and accomplishing it quite as reliably as would an operator who was subject to forgetfulness (as some are at times). Another valuable purpose that these small plants often fulfill is that of giving service to remote or outlying distribution systems when segregated due to sys-

*Sub-committee on Automatic Generating Stations of the Apparatus Committee: R. C. Denny, chairman; A. J. Hall, E. E. Valk, A. W. Coply, G. H. Bragg, H. L. Doolittle.

tem troubles, and from that standpoint alone their operation might well be justified. In fact, rarely do such small plants individually have any importance to a large generating and transmission system other than those just pointed out. Collectively, their output is of importance, as it is safe to say that every member company's system has use for every kilowatt-hour that can be produced at all economically.

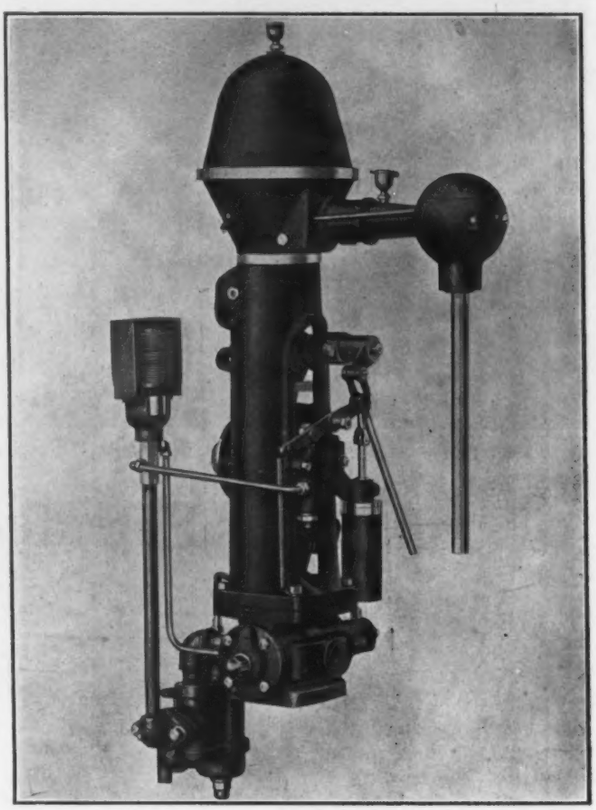
The Southern California Edison Company has in service nine semi-automatic generating plants, totaling a capacity of 14,655 kw. in seventeen units, ranging in size from 250 to 3,000 hp., working under static heads of 305 to 1,150 feet. These are all old plants that have been changed over from manual control and having both impulse and reaction type turbine (the former predominating), direct connected to synchronous generators. The largest number of units in any one plant is three, these being of 250 hp. each. Few of these plants have any appreciable storage capacity at their forebays, consequently their operations must conform to the amount of water flowing. This is accomplished by means of float control of the turbine gates or nozzles to vary the load to correspond with variations in flow.



Direct current operated gate control to shut down induction generator in event of runaway. San Joaquin Light and Power Corporation.

The San Joaquin Light and Power Corporation is at present operating three semi-automatic generating plants, and within the near future will have two more in operation. The generating capacity of the five will total 8,775 kw. in five units, ranging in size from 475 to 5,000 hp., operating under static heads of 45 to 405 ft. Two of these plants were entirely new developments as semi-automatic plants and employ induction generators directly coupled to reaction type turbines, while the other three plants are being changed over from manual operation and employ synchronous type generators direct connected to reaction turbines. Four of these plants are operated in series effecting control of stored water, one of them making its load changes automatically by means of float control, while the load changes at the others are made manually at the dispatcher's orders. The fifth plant is entirely independent of any stored water, being a stream flow plant also employing float control.

The Ontario Power Company of Ontario, California, has two remotely controlled generating plants entirely automatic in their operation. These are of 500-kva. and 400-kva. capacity, operating under static heads of 310 ft. and 284 ft., respectively. The generating equipment comprises synchronous generators direct connected to impulse type turbines. Both plants were entirely new developments as automatic plants and in lieu of steam generation or purchased power. In their operation these plants affect the flow of water for irrigation purposes and consequently they must persist in uniform operation or interfere seriously with the irrigators. Obviously, water spilled into the natural channel at the head works, due to a plant closing down even for a short period, would come along later after the plant was again under load and increase the head in the irrigation ditches. This has had its effect on the plan of operation of these plants and the application of automatic features to gain the desired operation. Float control of the load is not used, the nozzles or deflectors being controlled from a third plant, where an operator is in attendance at all times. The flow through the plants may thus be maintained constant, regardless of whether or not the units are in operation.



Automatic starting mechanism, solenoid operated, applied to control parts of Woodward Oil pressure water wheel governors.

The two plants just described are the nearest approach to the entirely automatic generating plant among the companies of the P. C. E. A., particularly one of them, which goes on the line automatically at synchronous speed and has its field energized. At all the other plants mentioned it is necessary for an attendant to actually be in the plant to synchronize the unit on the line, excepting, of course, the induction generator plants, where the units are simply brought up to synchronous speed and closed in on the line.

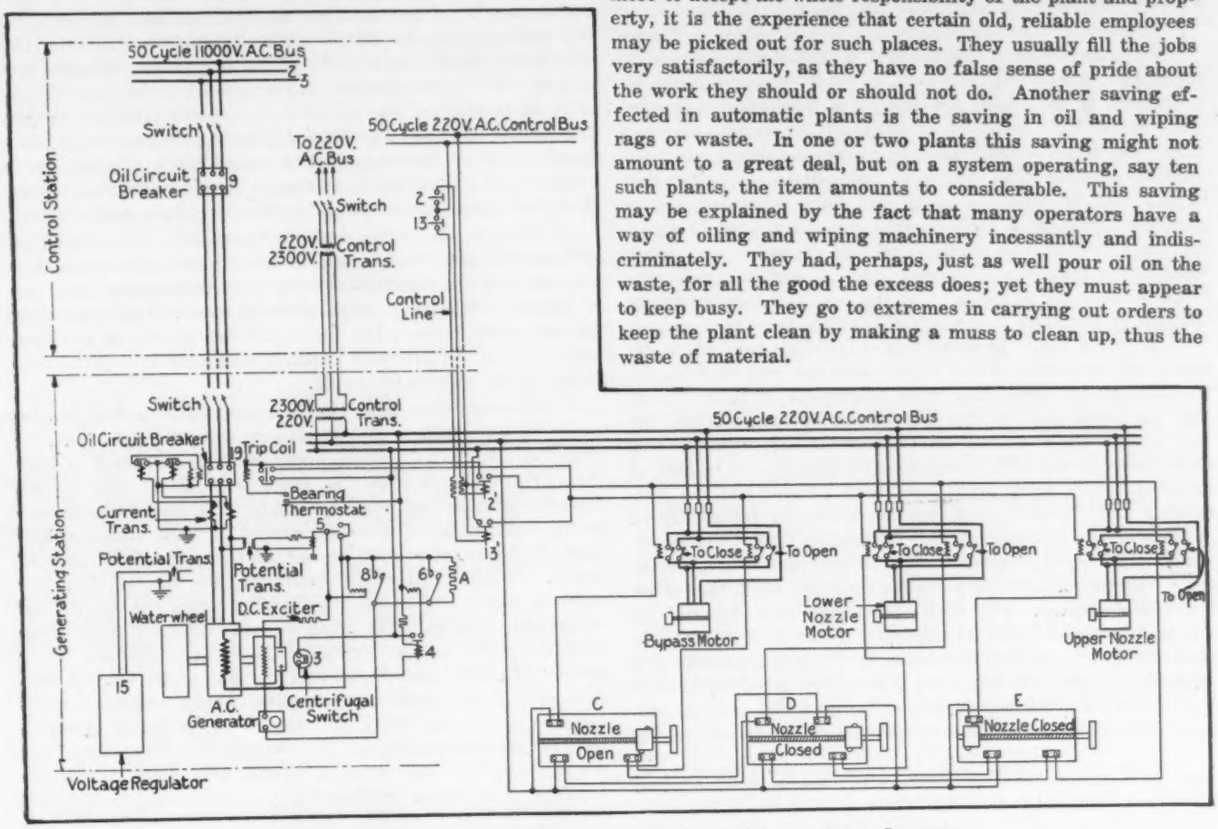
As to automatic features and operating circuits in the plants we find the similarity anticipated at the outset, although some very original and novel schemes have been employed in connection with float control of load, particularly those to prevent overtravel of the governor by means of intermittent contact-making devices in the governor control motor circuit. Where the plants are remotely controlled there is always some indication at the control station of the load, either directly by wattmeters or in terms of gate opening. In this connection one of the electrical manufacturers has developed a unique system of monitoring the operation of the automatic features in a plant by listening in over the telephone. By means of selector switches the operating condition of any particular device may be ascertained or all of

them in proper sequence. Needless to say, the indication is transmitted by means of a code rather than phonographically. One of the manufacturers of oil pressure governors has brought out a solenoid operated control valve which operates directly in connection with the governor and which may be acutated by float or remote control. In this connection, also, an automatic brake has been devised for holding the gates at any position and preventing them from drifting.

One feature common to all automatic generating plants is the overspeed device for preventing disastrous runaways. These are standard devices made by several electrical manufacturers and in which the operating principle is that of a lever displaced by centrifugal force in opposition to a spring. They function at a pre-determined per cent overspeed to either close or open a circuit, which through auxiliary relays causes the water to be shut off from the turbine. This is best accomplished by tripping the governor safety latch, which practice is followed in many of the plants. The real danger from runaway of synchronous generator units is that from high voltage, which may either break down the insulation or cause flashovers, resulting in destructive arcs or generator burnouts. Therefore, the high voltage cutout relay is common to most automatic synchronous generator plants. It functions at a predetermined over voltage to insert additional resistance in the exciter field circuit, which reduces the generator voltage to a safe value. These also are standard devices. They may be used in connection with an automatic voltage regulator if the plant be equipped with one and prove an additional safeguard.

In most all the automatic plants the bearings are equipped with thermostats or temperature relays, which function at a predetermined temperature rise to shut down this unit. These too are standard devices. Troubles either in the generator or on its cables, due to breakdown or in case of loss of excitation, are generally cleared by differentially connected overload relays or by reverse power relays which function to trip the generator switch and then open the field switch. The plants are generally protected from line troubles by overload relays of the inverse or definite time relay types, usually the former. Governor oil pressure system troubles can, by means of pressure regulators, operate auxiliary relays to close the plant down or to signal an attendant, likewise in case governor belt failures which would in some cases overload the plant. In practically all plants changed over to automatic operation it has been necessary to apply numerous home-made or make-shift devices in the absence of standard devices. However, at the present time there are several of the large electrical manufacturers who are prepared to quote on completely equipped automatic generating plants in capacities up to 10,000 kva., which is quite a notable advance in the art.

Under actual benefits derived from automatic operation we may point out that many of the small plants discussed thus far are stream flow plants, or those affecting seasonal control of stored water, and as a result are subject to quite low load factor operation. In fact, two such plants of 425 and 1,000-kva. capacity have over a four years' period of operation averaged load factors of 60 per cent and 23 per cent, respectively. It is felt that they have done well to produce power at the same average rate per kilowatt-hour as the larger hydroelectric plants of the system. Obviously, their operation as manually controlled plants would result in prohibitive production costs. In other of the automatic plants operating at higher load factors, kilowatt-hour costs will be further reduced, even justifying in many cases one attendant where it is the desire to have a caretaker on the property. This brings up another point of advantage in semi-automatic operation, in that unskilled attendants may be used in such plants. Even though it is sometimes necessary to pay a man more to accept the whole responsibility of the plant and property, it is the experience that certain old, reliable employees may be picked out for such places. They usually fill the jobs very satisfactorily, as they have no false sense of pride about the work they should or should not do. Another saving effected in automatic plants is the saving in oil and wiping rags or waste. In one or two plants this saving might not amount to a great deal, but on a system operating, say ten such plants, the item amounts to considerable. This saving may be explained by the fact that many operators have a way of oiling and wiping machinery incessantly and indiscriminately. They had, perhaps, just as well pour oil on the waste, for all the good the excess does; yet they must appear to keep busy. They go to extremes in carrying out orders to keep the plant clean by making a muss to clean up, thus the waste of material.



Wiring diagram of remotely controlled generating station of Ontario Power Company.

It is a very difficult thing to say where the line should be drawn in regard to the size of generating plants to operate automatically or even semi-automatically. So many considerations enter into such a proposition that each development of the sort deserves its own particular study, and in every case a very careful study is the height of wisdom. The operating charges in any hydro plant, which are largely labor charges, may vary anywhere from one-half to one-fifteenth of the total kilowatt-hour costs. Such variations are governed largely by fixed charges and load factor operation. These things are, therefore, fully as important or more so than operating labor in considering new automatic plant installations, otherwise they may not turn out to be as economical as anticipated.

These very considerations would tend to indicate that the automatic plant must be based on much the same set-up as any plant. Also, since the labor saving in an automatic plant is practically the only saving, it is an important item only in smaller plants or in larger plants that are subjected to poor load factor operation, for in plants of large output and high load factor operation the labor charge per kilowatt-hour is insignificant. It is only too obvious then that while large plants may be made to operate automatically, there is little to be gained by it, as the plant investment is fully as great as for the other type plant, the automatic features possibly even offsetting the saving in operating labor.

Even though the size of automatic plants may be unlimited, so far as possibilities are concerned, there is a limit of practicability. This is rather governed by the importance of the particular plant to the entire system of which it is a part. It is obvious that any plant that represents in itself a large percentage of the system generating capacity, should not be tripping off the line for various minor and inconsequential things that might be remedied if there were an operator in attendance. Even in the case of line troubles or disturbances, the judgment of a good operator very often saves an interruption, where the automatic plant would in some cases by tripped off unnecessarily. From the standpoint of plant safety, too, there is much that can be said, particularly in regard to fires starting from minor arcs or oil explosions. In such cases the relay protection may function to save the generating apparatus, but it does not put out the fire. The presence of an operator with a fire extinguisher in such cases is indispensable.

While the committee cannot attempt to state the practicable size of automatic generating plants, it has been the endeavor to bring up and point out the various points of practical consideration as having the most bearing in the matter. We are unquestionably living in an age of stunts, so that it behooves engineers to exercise very sound judgment in any consideration of automatic features merely to replace the human element.

Standardization of Practices Recommended in Purchasing and Storing

By C. A. Kelley*

THE committee recommends that the wastefulness of the frequent and indiscriminate use of the "emergency purchase order" should be brought to the attention of everyone in our different organizations, to every employee of all the companies. In its proper use and place the "emergency purchase order" is of great advantage and will save both time and money, but the committee feels that often the emergencies are imaginary rather than real, and that articles are purchased in this way to satisfy a particular whim or notion of the purchaser, whereas a little thought would have led to securing the article in the regular and less expensive way or in substituting from the storeroom stock a similar article that would answer the purpose. Not the real, but the imaginary emergency purchase is the wasteful and extravagant one.

With the desire to expedite and facilitate company operations and construction and to cut down the cost thereof, the members of the committee were unanimous in their feeling that the importance of the purchasing department and the stores department should be stressed in all organizations. Often work is seriously hampered and delayed due to lack of material, which delay could have been avoided had the purchasing and stores departments been advised sufficiently in advance of the proposed needs. It was felt that if the representative of the departments could be apprised of or be present at the inception of the plans for proposed work, that often the final completion of that job would have been expedited by the departments having the material, if standard, on hand in sufficient quantities for the work, or if special, having the sources of supply investigated and, where possible, obtaining options on the best delivery of the material needed. The committee recommends that representatives of the purchasing and stores departments be invited to attend the meetings of the engineering committee or other committees that might discuss and decide on matters pertaining to the standardization or the need of material and supplies. To be forewarned is to be forearmed, and the earliest possible information the purchasing and stores departments could have regarding proposed needs of the organization would make it that much easier for the departments to supply the demands when made, thus facilitating the work and cutting down the cost thereof.

The purchasing and stores departments do not wish to dictate standards, but rather to learn what those standards are; nor is it the intention of these departments when hearing of proposed extensions to purchase at once without authority the materials needed, but the departments wish to gain an early idea of the proposed possible needs and line up the material or the sources of supply.

The committee feels that a considerable saving can be made in the printing and stationery department by careful study of the sizes in which paper stock is furnished and by investigating what sizes this stock may be cut into by the fewest operations and the least waste. The committee recommends that the sizes thus determined be made standard and that all forms be printed on one of these standard sizes of paper. This would tend to standardize the size of filing envelopes, boxes and cases, thus cutting down the waste and extravagance of manufacturing so many different sizes. This standardization can be carried to the desks, tables and other articles of office furniture, as well as many of the articles carried in our materials and supplies. The committee commends the excellent work of some of the technical committees on standardization of line material and the like, and recommends that the different electric companies, as far as possible, standardize on these many articles used in line and

*Purchasing and Stores Committee: C. A. Kelley (chairman), F. W. Smith, C. E. Barschig Jr., C. R. Eccles, J. L. Gray, F. F. Henry, J. H. Hunt, D. P. Mason, W. J. McCullough, G. C. Robb, C. D. Weiss.

station construction as being the best way to avoid additional cost of multiple manufacture as well as being an excellent way of cutting down inventories and the cost of maintaining large supplies.

The committee recommends that all shippers be instructed to plainly mark packages with the purchase order number and the purchase requisition number. Likewise invoices, shipping bills and other papers in connection with the same should be marked with the order and requisition number. The committee feels that such marking is so important that all receivers should use their utmost endeavor to see that such instructions are complied with.

The committee recommends that whenever, in an organization, the standard affecting any article of supplies in the storeroom is changed or a new standard is adopted, that definite information relative to the change or adoption, approved by the proper and final authority in the matter, be forwarded to the purchasing and stores departments. At the same time definite instructions from the proper authority should also be forwarded to the stores department relative to the disposition of the material supplanted by this change of standard or adoption of a new one. The stores department should be definitely notified whether it is to junk and scrap the old material, move it elsewhere, use it for another purpose, or continue to issue it for its original purpose until entirely disposed of.

The committee rcommends that all unapplied material in any organization should be in the custody of the stores department.

The committee recommends that each stores department should issue what would be known as "Stores Department Book of Rules." This book should be issued in some loose leaf form to facilitate additions and revisions and should set forth detailed information relative to the stores department forms and their use. Among other things, this book should give the names of the form as well as the purpose of the same, also how and by whom the form should be prepared, the number of copies to be made, the distribution of the several copies and the handling of the same by those receiving such copies.

The committee recommends that each stores department should issue in suitable loose leaf form a book to be known as "Standard Lists of Materials Carried in Stock." This book should contain a list of all such material, designating the article by the proper name according to the dealer's catalog, the proper description of the article and its use, and such other information as will enable the party desiring the same and the storekeeper handling the same to quickly and accurately identify and procure it.

Ordering

Under the above heading the committee recommends the following:

To facilitate reference and insure permanency, all purchases should be made upon written requisition only. Where emergency demands the purchase may be made upon oral request, but this should be followed immediately by the written requisition.

To insure legibility, as well as neatness, all forms used in requisitioning material should be typewritten.

Anyone authorized to order material, or, in other words, to prepare requisitions, should have the following information:

Correct description of the article wanted.
The correct quantity.
The correct charge.
The purpose for which to be used.
Correct consignee and shipping point.
Date upon which the material is needed.

This information should be accurately entered upon the requisition and the party making the same should then secure the necessary approval and see that the requisition is placed in the hands of the purchasing agent without delay.

In ordering material for the replenishment of stock it is of the utmost importance that the party preparing a requisition know exactly:

The usual source of supply.
Quantity on hand.
Quantity on order.
The average monthly consumption of the article.

If it is a seasonable item, that fact must be taken into consideration and the quantity increased or decreased as conditions warrant.

Orders for stock should call for standard package quantities or multiples thereof. Orders for special items should call for the exact quantity desired.

The requisitioner should be supplied with a "List of Standard Materials Carried in Stock" and should requisition exactly according to the description therein.

Purchasing

The public gains its impression of a public service corporation through contact with its employees. This applies as truly to the purchasing department as to any other branch of the business.

The purchasing agent should have full charge of all purchasing, with, of course, the privilege of securing assistance from others of the organization where necessary.

All requests for prices should be made by the purchasing department. The purchasing department may delegate to representatives of different departments authority for selecting of material, but the actual purchasing should be done only on an approved purchase order through the purchasing department.

The organization of a purchasing department will depend upon the size of the corporation, but should be so organized as to facilitate operation, as delay in this department can be both costly and annoying. Where feasible, purchase of material should be segregated and assigned to different members, to make possible a better knowledge of the material and the sources of supply, and to avoid the possibility of different ones attempting to secure the same article at the same time.

Action by the purchasing department is called for by the receipt of the requisition.

These requisitions having first been checked as to correctness in details, should, where the organization permits, be distributed to the several buyers, who through their familiarity with certain lines, are often able to recognize the good buy at a glance, thereby saving time of obtaining quotations, facilitating quick delivery where needed, and likewise making it possible to take advantage of exceptional offers when presented.

The source of supply having been determined, the purchase order should be issued promptly, giving full details of the articles required and specific instructions as to shipment and delivery. Sufficient copies of this order should be made to properly notify all those interested in the purchase.

The committee suggests the adoption of a standard purchase order form, similar to the accompanying illustration. This form does not attempt to prescribe exactly what should be printed in detail thereon, but does prescribe that it should be printed on standard size paper which will cut without waste—namely, 8½ x 11, or 5 x 8—and that such information as each organization desires on the order shall be placed in the same relative position. The committee believes that such zoning of information and instruction would be of great benefit to dealers and will enable them more quickly and accurately to comply with the purchaser's order.

Acknowledgment of the order from the vendor should be insisted upon to assure the purchaser that the order has

been received and that the parties to the contract are mutually agreed upon all terms upon which the order is placed and accepted.

The responsibility for delivery of material to the shipping department should be placed upon the purchasing department. Purchase orders should be followed up to insure that vendors ship material on the date promised.

The committee suggests that all bills of lading or other shipping papers, as well as all invoices, go first to the purchasing department. This routine will inform the purchasing department that shipment either entirely or partially has been made, will avoid further necessity of following up the vendor and will give the required information for tracing the shipment, if necessary, with the carrier.

Many orders are shipped promptly, and these ordinary routine matters need not be particularly traced unless shipping department acknowledgment of receipt of the goods does not come through immediately after promised shipping date. In the purchasing department a follow-up system should be established that will automatically call for inquiry upon the vendor if the shipment has not been made at the expressed time, and insure the prompt following up of the vendor until the shipment has been made.

Prompt receipt of vendor's invoices should be insisted upon, and the same must be legible and specific, carrying the necessary details to avoid confusion and facilitate approval and payment. These invoices should be checked carefully as to price and calculation.

The committee recommends that a complete purchase and cost record of all orders be kept by the purchasing department.

These record sheets and cards should be of a standard size and should be indexed under the name of the article purchased. They should show the order number and date, the name of the vendor, the quantity purchased, cost and the unit price. Particular companies, according to their organization, location and the methods of business, may desire other details.

Routing instructions for shipment should be issued at the time the order is placed. If an organization has a proper traffic department the routing can well be taken care of by that department; otherwise the responsibility therefor should be upon the purchasing department.

Receiving and Checking

The receiving department should be furnished with a copy of the purchase order to identify and check the shipment. All packages and shipping papers should be plainly marked with the purchase order number and the purchase requisition number.

The receiving department should check all shipments and make a report thereof on a form suitable for the purposes of the organization.

Visual inspection, and where advisable, detail test should be made of all material received by the receiving department. Where deemed necessary the article should be passed for further test to the laboratory or other test department. Written reports of these tests on proper and suitable forms should always be made, signed and forwarded without delay to the party properly interested therein.

All goods should be opened and inspected for overages, shortages and damages. When any develop, the material should be held in the original container, railroad inspector called when necessary and proper papers executed. An "over," "short," "damaged" or "unsatisfactory" material report on a proper form should be made up, all available papers attached thereto and sent to the proper department as the claim may indicate.

The receiving department should receive all freight and express bills and approve the same for distribution of charges and payment.

The committee recommends that freight and express charges be paid by draft, accompanied by original freight bill or express receipt, rather than from petty cash.

Storing

The necessity for storing is to provide materials for immediate use. If market conditions were ideal, purchases would for the most part be made as goods were needed, the quantity of stores carried would be comparatively small, and the problem of storing would not be troublesome. But those conditions do not exist, due chiefly to:

Inability to obtain quick deliveries from local dealers.
Necessity of supplying materials for emergency repairs.
Great distance from source of supply.

The committee recommends the practice of sectionalizing stores stock for convenience of storage and issuance of material as follows:

Sec. 1. Acids, cans, carboys, drums, greases, oils and paints, etc., motors, motor starters, panels, regulators, relays and transformers, except current, potential and street lighting.
Sec. 2. Meters, current, potential and street lighting transformers and telephones and parts.
Sec. 3. Electric material—general. Does not include wire, cable or miscellaneous repair parts.
Sec. 4. Hardware—line construction, miscellaneous pipe and fittings, shelf hardware, tools, etc.
Sec. 5. Bar and sheet brass, copper, iron and steel, insulating material, transformer bushings, magnet wire, miscellaneous repairs parts, etc.
Sec. 6. Cross-arms, guy covers, lumber, wood pins and poles.
Sec. 7. Cable, cord, wire and wire reels.
Sec. 8. Stationery, office supplies and fixtures and electrical appliances.
Sec. 9. Scrap and obsolete materials.

After purchased material is receipted for by the receiving department, stockmen should take charge thereof and segregate according to the above classification.

Miscellaneous hardware, electrical supplies, stationery, packing, etc., should be placed on shelves in a careful manner and in alphabetical order, according to classes; the old stock in front and the new stock in rear. This saves deterioration in all stock. Not more than one package at a time should be opened.

Materials should be stored, insofar as conditions will permit, in such a manner as will require the least handling considering its movement both from the receiving department and to the shipping department, or to the department using the materials.

The store inventory should be taken by a separate inventory, card being made up for each item of stock. This card gives the section number in which the material is kept, description of material, amount on hand, received after count, issued after count, and unit price. This card should then be checked by a representative of the audit department and entered into the ledger or stock cards showing correct amount on hand and card number. All stock should be placed on the shelves in such a manner as to be convenient for inventorying without removing from the shelves.

A label should be placed on the front of the shelf, giving a full description of the material. This material should at all times be kept in this one particular place and in the condition outlined above. The descriptions on the labels should be the same as those in the stock ledgers or stock cards, which are correct according to "The Standard List of Material" and descriptions in dealers' catalogs.

In order to facilitate delivery of fast moving store materials, the committee recommends the adoption of standard package quantities of knobs, pins, insulators, lag screws, bolts, etc. These may be carried in packages or placed in bundles or boxes in quantities suitable for shipment to other store-

rooms or for issuance to shop or line crews, according to the nature of the article, use thereof and the demands or other details of the particular organization.

Disbursements and Returns

No disbursements should be made from any storeroom, except upon presentation of a written requisition on a proper form.

No material should be returned to any storeroom without written receipt being issued therefor on a proper form.

The accuracy of the records of material and supplies issued is of first importance, and stores department employees should give careful attention to disbursements with the view of getting the record of each item issued, where it went and the purpose for which it was used.

The committee recommends that all transfers of material between stores should be made on a form of standard size, so constructed and of sufficient copies to entirely complete the accounting for the transaction. Acting as a requisition on the general stores, a receipt for the goods, an invoice for the material transferred, where necessary a requisition on the purchasing department, and a shipping manifest. This recommendation is made to avoid rewriting the list of materials during the operation of completely supplying the requisitioning storekeeper, except in cases of the general store back-ordering; when a similar form of standard size of sufficient copies should be made up for the particular items back-ordered.

The committee recommends that all sales should be made through the sales department, and that no material be issued for sale from any storeroom except upon a written regular sales department order, made upon a form of standard size with sufficient copies to inform those interested and to insure that the transaction is properly carried out and accounted for.

Accounting

The committee believes that experience has shown that it is very difficult to get persons in the various organizations handling material and supplies, outside of those actually engaged in accounting for the same, to realize the importance of properly accounting for materials and supplies. Storekeepers and their assistsants can be of great help in this respect by fully realizing this responsibility and by impressing it upon the others in the organization through personal contact and solicitation.

The committee realizes that through differences in size, location and methods of operation of our different companies, standardization of forms is a difficult problem. The committee feels that for the present standardization of practices is of considerably more importance than standardization of forms, and except in a few instances have not and do not at this time wish to recommend standard forms, but prefer for the time to bring out the best practices in each organization, and where possible have them applied in all organizations. This, in time, will undoubtedly bring out some general style or classes of forms, but the committee feels that the doing or carrying out of a proper method or routine is of more importance than of a particular detailed way of performing that task.

In conclusion, the committee wishes to state that it feels the Pacific Coast Electrical Association has taken a forward step in the past year by organizing the Purchasing and Stores Committee, and the members individually wish to thank the officers of the association for their individual appointment to this committee, as the personal acquaintanceship and the interchange of ideas at our several meetings has already resulted in the adoption by many of us of some practice, method or idea which one or more of the other members of the committee had already put into successful operation. It was our first year, and some time was necessarily consumed in getting acquainted, organizing and working out details with which none of us were familiar. As stated, already this interchange of ideas has borne fruit, and we trust that our report, incomplete as it necessarily is, will be of benefit to us and our associates in our several organizations, and we recommend that the Purchasing and Stores Committee continue as an activity of the Pacific Coast Electrical Association.

<table>
<tr><td>ZONE 2. Space of one inch is reserved for name, address, etc., of Buyer.</td><td rowspan="2">ZONE 1.
Space is provided for necessary instructions of buyer and seller, in upper right hand corner, convenient for reference in loose file or binder.</td></tr>
<tr><td>ZONE 3. For name and address of Seller to whom Purchase Order is to be mailed</td></tr>
<tr><td colspan="2">ZONE 4 Is used for shipping instructions</td></tr>
<tr><td colspan="2">ZONE 5. Is devoted to general conditions of purchase</td></tr>
<tr><td colspan="2">ZONE 6. Is for listing materials ordered</td></tr>
<tr><td colspan="2">ZONE 7. For the signature of the Buyer</td></tr>
</table>

Standard Zone System Purchase Order Form

The Zone System will to all intents and purposes, serve as a Standard Purchase Order Form, in that each item of information will always be found in a definite place.

The upper part of Zones 1 and 2, may contain information not necessary for the seller but of value as a record for the buyer, and may be detachable by perforation on the original copy, and any other special requirements necessitating more or less space on the form, can be accommodated, without affecting the zone arrangement.

The Zone System can be adapted to any size sheet, but two sizes, 8½ x 11 in. and 5 x 8 in., which are most generally used, are recommended as standard for the Zone System.

Note: Standard Zone System, Purchase Order Form adopted by N.A.P.A. at Rochester, N. Y., May 19, 1922.

Recent Developments of Alternating Current Substations

By R. C. Powell*

THE principal features of interest in the practice of a.c. substation construction and operation are the progress in outdoor design and application, and the development of automatic reclosing control. This report will, therefore, be devoted largely to these subjects.

Outdoor Substations

All necessary substation equipment can now be purchased for outdoor installation and excepting in the congested business areas of the larger cities it is now becoming standard practice to place a large part if not all of the equipment outdoors.

The question of how much to place outdoors is answered largely by the character of load supplied and the service requirements. For unattended stations it is the usual practice to make a straight outdoor installation, but if attendance is required the construction may be modified by placing lower

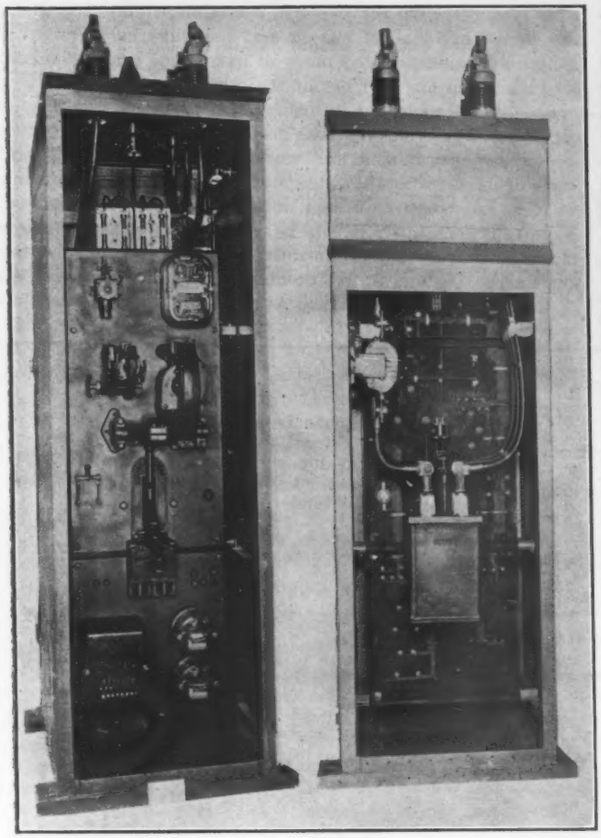


Fig. 1—Front view (left) and back view (right) of 4,000-2,300-volt, 3-phase, 4-wire type "G" switch house complete with periodic reclosing relays and clapper operated breaker.

voltage (2.4 and 4 kv.) switches, regulators, etc., indoors. In stations where rotating apparatus is operated the outdoor features may be modified still further by placing higher voltage, say 11-kv., buses, etc., indoors.

The desire for reduced cost of investment has been largely responsible for the introduction of the outdoor idea. While this has been realized for high voltage stations, for many low tension stations too much elaboration of the outdoor features has undoubtedly resulted in greater cost. Out-

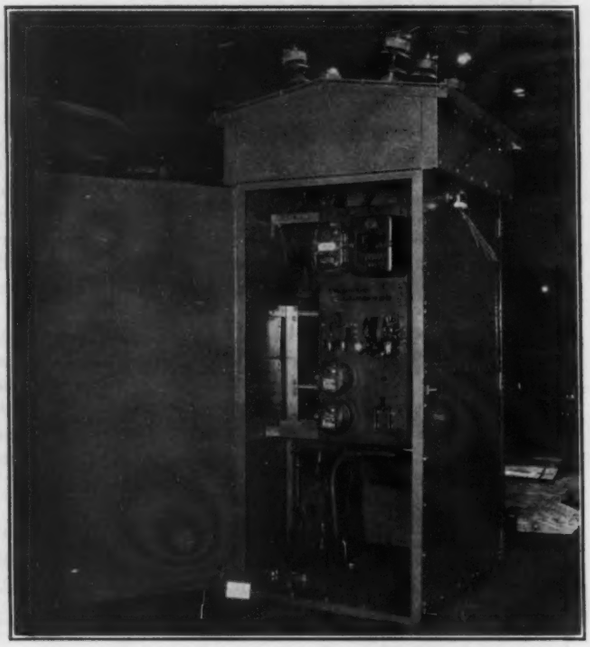


Fig. 2—Front view of 13,200-volt, 3-phase periodic reclosing switch house with type "B-2" breaker and a.c. solenoid mechanism.

door construction does, nevertheless, lead to one extremely desirable feature, namely, greater separation of conductors and the removal of oil filled apparatus from confined spaces. The failure of such apparatus with possible scattering of burning oil does not present the same liability for complete destruction of the station that indoor installation does.

Automatic Substations

In order to reduce operating costs without impairing service—indeed, in many cases it is the means of improving service—automatic control for the operation of a.c. substations has been developed. Although the idea followed naturally after the successful operation of d.c. automatic substations, the purposes are somewhat different. Both, of course, eliminate almost entirely the labor cost for attendance. For the d.c. station, however, the principal objective is to meet load requirements economically by automatically cutting in or out the necessary converting capacity; but for the a.c. station the principal objective is more economical protection to service. It has often been found in practice that a circuit breaker closed immediately after opening automatically upon overload will remain closed, that is, the cause of opening was a momentary overload such as the swinging together of conductors, or a short circuit which cleared when the circuit was opened and remained clear after the circuit was closed. This reclosing is done by automatic control and thus dispenses

*Alternating Current Substation Sub-committee of Apparatus Committee: R. C. Powell, chairman, W. R. Battey, C. E. Schnell, W. C. Smith, W. P. L'Hommedieu.

entirely with attendance for switches controlling circuits which are not involved in system switching operations.

Automatic reclosing control may be used to advantage under the following conditions.

1—To replace attendants.

2—To improve service at unattended substations.

3—To reduce attendance or improve operating conditions in large attended stations where the operator has a variety of apparatus to attend.

4—To improve service on rural lines covering a considerable area by installing automatic reclosing switches on branch lines where they tap the main line so that trouble on the branch may often be cleared without interrupting service.

There are a number of schedules upon which reclosing control devices are built to operate. These may be roughly divided into two classes: 1—those which reclose instantly or with definite time interval; and 2—those with selective action, time or load being the agencies affecting the selection.

A general description of the operation of the various schemes will be given more in detail.

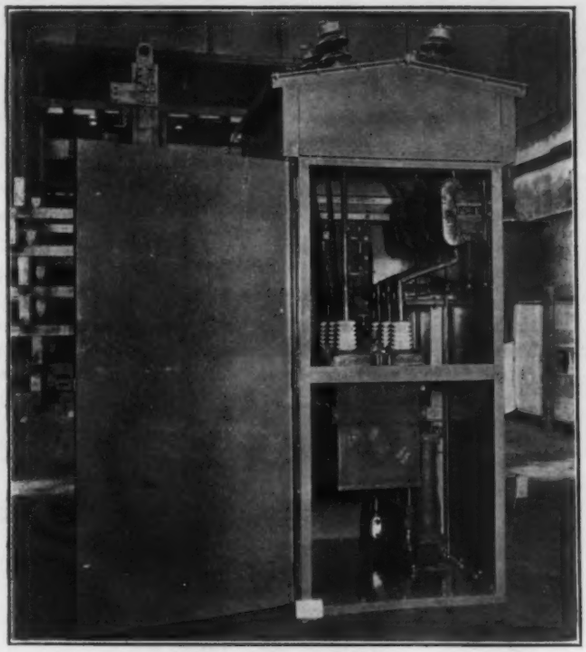


Fig. 3—Back view of Fig. 2.

Scheme 1.—This is the simplest. As soon as the breaker opens on overload it is closed immediately by the reclosing control. If the short circuit has not cleared this is repeated until the short circuit is cleared or the breaker has opened three times, whereupon it is automatically locked out and must be reset manually.

This scheme has two advantages: first, it places severe duty upon the circuit breakers; second, it may not in some cases give sufficient time between openings and closings of circuit to successfully clear short circuit.

Scheme 2.—Under this scheme the objections of Scheme 1 are met by the addition of a relay which controls the time interval of closing, that is, the breaker can close them only after a definite time interval, usually 30, 60 or 120 seconds, although this interval may, of course, be other values if desired.

According to the tentative recommendations of one manufacturer, the rating of a breaker is reduced to the values given in the following table:

RATINGS OF OIL CIRCUIT BREAKERS WITH AUTOMATIC RECLOSING

No. Automatic Openings		Time Interval seconds	Per cent Rating
2	Automatic Openings (2 shots)	240	100
3	" " (3 shots)	240	80
3	" " (3 shots)	60	70
3	" " (3 shots)	30	60
4	" " (4 shots)	30	50
3	" " (3 shots)	1-2/3	40

Scheme 3.—Under this scheme, which is a combination of Schemes 1 and 2, the severity of the short circuit selects the sequence of operations. If an overload of less than 50 per cent of feeder short circuit current occurs Scheme I is put into operation and the breakers operate three times consecutiively as quickly as possible, but if the overload exceeds 50 per cent then Scheme 2 is put into operation. This scheme has the advantage of keeping synchronous apparatus in step upon the occurrence of less than 50 per cent of feeder short circuit current, and reducing the duty or the breaker for currents exceeding 50 per cent. The time interval for the heavy short circuit condition is usually set for 240 seconds.

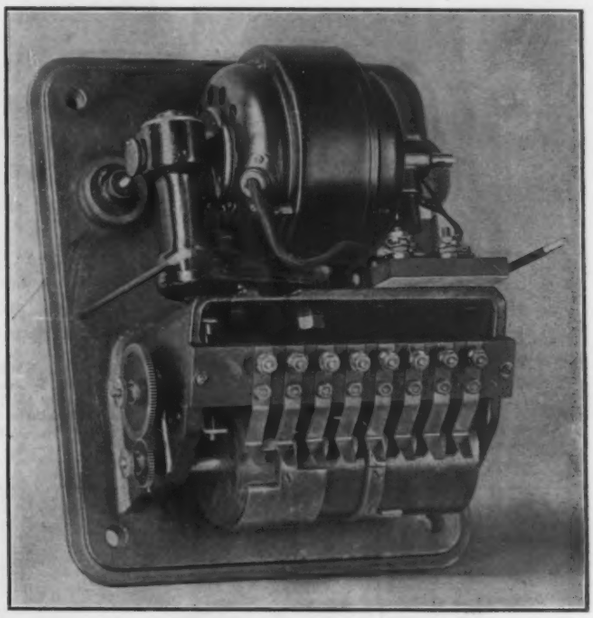


Fig. 4—Interior view of periodic reclosing motor relay. Arrow indicates extra timing gears.

Other schemes may also be employed. For example, in a station with d.c. control circuits supplied from a battery of limited capacity there is a possibility that the battery may be ruined or that the breakers may not operate if a number of breakers open simultaneously. Hence, a relay is introduced so that only one breaker may operate at a time.

Oil Circuit Breakers

With the rapid growth of generating systems it is well to check up the capacities of oil circuit breakers, and it must not be forgotten that many of the breakers in service may be dangerously overloaded as regards rupturing capacity. In order to correct this, either reactors or breakers of higher rupturing capacity must be installed.

Induction regulators: The current which an induction feeder regulator will safely withstand in the event of a feeder short circuit is limited to 25 times rated amperes and a number of failures of regulators have occurred due to heavy short circuits.

In certain cases where induction regulators are in circuits supplied from transformer banks of very low impedance it may be necessary to install reactors.

Progress and Development of Overhead Transmission Systems

By J. A. Koontz*

THE past year has shown material growth and progress in the development of the overhead plants on the Pacific Slope. Undoubtedly the most noteworthy advance will be the placing in operation of the first 220,000-volt transmission system—that of the Southern California Edison Company. These Big Creek lines will undoubtedly be operating at 220 kv. before this report goes to press. The changes on the system are of special interest in showing the advance in transmission practice. The company has taken the 150,000-volt steel tower system, and with minor changes, adapted it for use at the higher voltage. In many cases the towers had to be raised to take care of adequate clearance caused by the necessary lengthening of the insulator strings to accomodate the higher voltage.

The insulators to be used consist of eleven of the standard 10-in. clevise type units in suspension with a shield ring 28 in. in outside diameter, which is supported concentrically with the lower unit. The top of the shield is 11 in. above the conductor, is made of aluminum and is an inverted "U" shape in cross-section.

The line being of the single circuit type, with wires in the horizontal plane, arcing horns are used on the two outside wires at the points of insulator attachment. These arcing horns have a spread of 27 in., while on the center wire a 26 in. diameter ring made of iron is attached at the tower end of the insulator. (See. Fig. 1).

Dead-end insulation consists of two parallel strings of thirteen standard 10-in. units having an elliptical shield ring around the two units with single arcing horns on the tower end. Tie-down strings are composed of twelve standard 10-in. units with shield ring. This shield ring is slightly smaller than the suspension ring and is placed around the top unit next the line wire. (See Fig. 2.)

It must be borne in mind when considering this problem that the engineers were definitely limited by certain clearances which were originally designed for 150,000-volt operation, but on account of the liberal design it was possible to convert this system to the higher voltage at a relatively small cost compared to the cost of a new circuit.

The conductors, on account of aluminum having been used, had sufficient diameter, due to conductivity requirements, and by resort to the strategy of shielding, in order that the air at no place near the conductors or insulator support was stressed to the breakdown point, it is believed, even in the limited space available, that the Southern California Edison Company will get as reliable operation at the higher voltage as they have had when operating at 150,000 volts.

Poles

The pole situation in the West is becoming acute, in that the pole producers have not been able to keep up with the demand, it being very difficult to obtain seasoned poles at the present time. Practically all companies have standard-

*Overhead Systems Committee: J. A. Koontz (chairman), R. R. Cowles, P. O. Crawford, R. E. Cunningham, R. S. Daniels, E. N. D'Oyly, R. H. Halpenny, C. A. Heinze, W. A. Hillebrand, H. H. Henline, N. B. Hinson, J. P. Jollyman, L. M. Klauber, H. Michener, E. R. Northmore, E. Y. Porter, D. D. Smalley, E. A. Quinn, H. J. Ryan, T. W. Snell, P. M. Wentworth, R. J. C. Wood, C. E. Young, S. J. Lisberger.

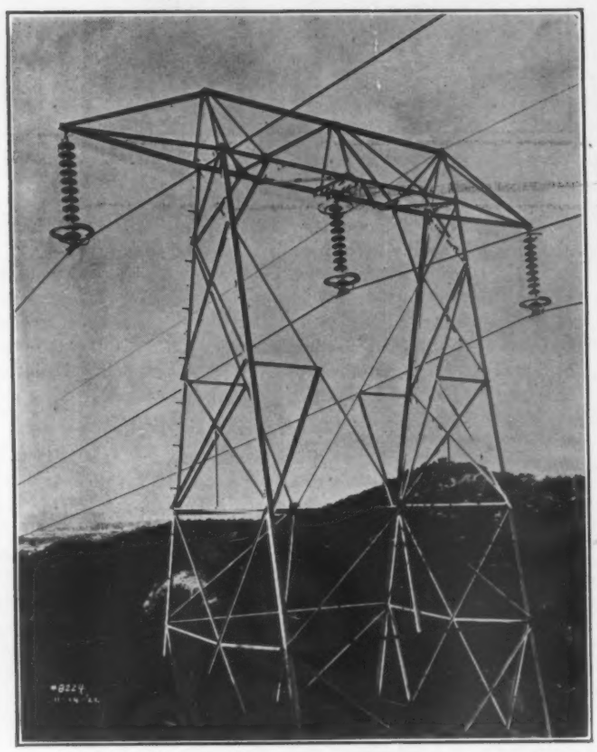


Fig. 1.—Aluminum shield rings on 220,000-volt lines of the Southern California Edison Company.

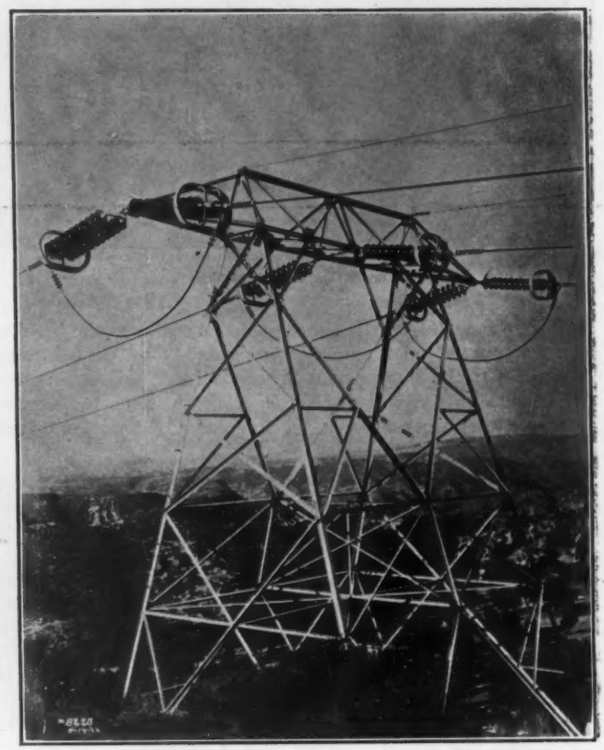


Fig. 2.—Aluminum high-tension suspension rings on the lines of the Southern California Edison Company.

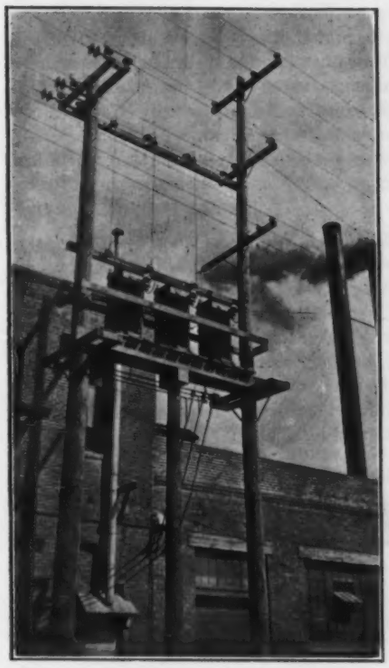


Fig. 3.—Fifty-five-foot joint pole installation of P. G. and E. and G. W. P. 11,000-volt lines. Three 75-kva. transformers with C. E. fuses.

Fig 4.—Fifty-five-foot joint pole installation of P. G. and E. and G. W. P. secondaries. Fifteen thousand-volt transformer with C. E. fuses.

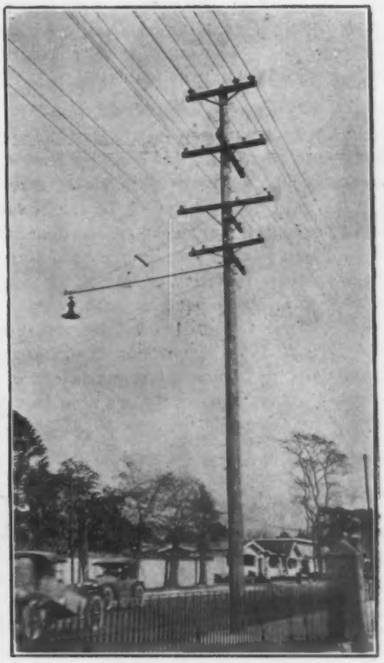


Fig. 5.—P. G. and E. 4-kv. primary, secondary and arc lamp. G. W. P. secondary. No. 3/0 copper, 18-in. spacing, 55-ft. joint pole.

ized on the creosote treatment, but are handicapped in getting poles sufficiently seasoned to get suitable creosote penetration. Some of the larger companies are even trying to anticipate their year's demands on poles of various classes and are purchasing their stock at least twelve months in advance in order that they may be certain of well-seasoned poles, and are building treating plants to do their own treating in order that they may be sure of the best results.

Termites have been giving some trouble in poles throughout central and southern California, and quite a study has been given to this matter. It appears that in general treated poles are not attacked by the ants to any extent, and that when they do work upon treated poles it is usually on poles which have season-cracked after treatment, and the ants are able to enter into these cracks and start in the wood below the penetration of the treatment. One company is considering the possibility of spraying the cracks in poles after same have been in service in order to try and eliminate these insects. The majority of the poles attacked are attacked near the ground line, or one to two ft. above, so that it would appear, in general, that the whole pole would not have to be sprayed, although occasional colonies of ants have been found in the upper portion of the pole.

Distribution Voltage

On account of the rapid development of this western district there have been numerous changes in distribution voltages during the past year on account of companies having to meet the rapid increase in load demands. The majority of these changes have been from 2,200 volts delta to 4,000 volts grounded star—in one case the change was made to 4,600 volts delta. There seems to be quite a growth also in 11,000-volt distribution, both 11,000 volts delta and 11,000 volts grounded star.

With the rapid growth in the use of electricity for domestic purposes, as well as in the manufacturing and industrial fields, the old distribution systems are becoming inadequate to handle the heavy loads which the public demands. It would seem that the time is rapidly approaching when high voltage distribution systems will be essential. There are two or three factors in this question which will presumably be the determining factors as to what the ultimate distribution voltage in any particular case will be. These are:

1. Cost, including both construction and operation.
2. Reliability.
3. Grade of service required.

With the lower distributing voltages, due to street congestion on both overhead and underground systems, there is difficulty in getting the required space for ample circuits to handle the load. With the rapid growth of the heating load, voltage regulation is becoming more and more serious and primary regulation is more easily taken care of with the higher voltage.

Economy undoubtedly will force the public service companies to handle larger blocks of load from single feeders, but by better maintenance of the systems it is believed that the existing high-grade service can be maintained. Thus a portion of the distribution people feel that 11,000 to 13,000 volts distribution will, in general, be used in the larger cities or manufacturing districts before many years.

Because of the growth in loads and power systems it has been necessary to strength equipment along the line and tests have been made to develop high rupturing capacity fuses for transformers and line protection.

Considerable time has been spent during the past year in discussion and study of the new rulings of the California Railroad Commission and their application. Member companies throughout California feel that this work is a decided improvement over the National Safety Code for our local conditions.

At the time changes were being made relative to new orders the question of standardization was discussed, but it did not seem practicable to adopt any standards in connection with pole top construction at this time. However, one point should be borne in mind, and may possibly result in an ultimate saving—that is, the standardization of stock used for crossarm work. It is felt that there is a possibility of

standardizing on the size of timber used for various classes of crossarms, enabling the mills to carry large stocks for domestic use. The question of standardizing on the finished crossarm was not practicable.

Insulation

There have been no radical changes in insulation for a number of years. It has been a question of refinement of the product. The majority of insulator manufacturers are taking greater care in the handling of the elements which enter into their products; more care in the manufacture and assembly of the units; factory tests are becoming more rigid—so that the insulators installed on the lines today should give better service than those used in past years. The National Overhead Systems Committee has been making extreme temperature cycle tests on suspension insulators during the past year. Progress reports show that insulators of all types, as manufactured today, apparently are able to withstand temperature ranges of from 150° F. to 10° F. below zero, for several hundred cycles without serious consequence. The only failures that have occurred from this test have been units of the bomb and link type from one manufacturer, while the same units from another manufacturer have not been affected. With this in mind it appears that units of any of the three standard types as now manufactured can withstand a great many temperature changes and wide temperature variation without serious consequence. This was not true in units of older design.

Power companies are including suspension insulator testing in their routine maintenance work, although none of the companies are testing pin-type insulators. The megger is in most general use, especially on the higher voltage lines, the western companies being rather backward in their adoption of hot line testing, or hot line maintenance work. About the only general hot line work done in this district is that of tapping in or cutting out transformers on so-called distribution lines of 30,000 volts and less.

Testing and Maintenance of Electric Meters

By W. H. Talbott*

THE success of short courses for metermen, held at several of the universities in the East, was discussed by this committee and it was decided that such a course should be held on the coast. Through the cooperation of Mr. Smith, of the Extension Division of the University of California, plans were made to hold a course at the university, May 14 to 19, inclusive.

Investigation has been carried on for several years, relative to periodic testing of watt-hour meters, and the report this year must be considered as a progress report, as the committee feels that there are not enough records available upon which to make a decision as to the proper test period. The reports that have been received indicate that watt-hour meters which have been in service for a number of years, have tested within the range accepted as commercially correct.

Maintenance of switchboard instruments, meters, and relays, is a subject that is becoming increasingly important, and has been given more attention by the committee this year, than in the past. The following facts, with reference to existing practice, have been brought out:

1. That the meter department handles maintenance work done on switchboard instruments and meters, and that the relay work is handled by the department in about half of the companies. This work in other companies coming under the supervision of the operating department.
2. That there seems to be no general practice of a regular schedule for the checking of switchboard instruments, excepting those of the recording type which most companies check periodically or frequently. All other types are tested only when in need of repairs, or when doubt exists as to their accuracy.
3. That in general the "Overall" method of testing and setting relays is used.
4. That most companies use the same general type of apparatus for the testing of relays.
5. That it is the general practice for member companies to install bypass switches or test links on the secondaries of current transformers, to facilitate the maintenance of relays and instruments, these usually being installed on the switchboard.

The committee is of the opinion that it would be desirable to have developed, a convenient and practical method for checking relay connections, under the following conditions:

On many installations of reverse power relays, the current coils are fed from bushing type current transformers connected on a high voltage line while the potential coils are fed from potential transformers connected to the low voltage side of a transformer bank, this practice being used for the purpose of saving the cost of high voltage potential transformers. But with no transformer on the high voltage side it often becomes difficult to determine the power factor and correct connections for the potential leads to the relays.

For relay testing, there are in use two portable telephone units. These are found to be very valuable where overall testing is done. By conversing over these telephones for instructions regarding loads, etc., a great amount of time and travel is saved.

A suitable single and double potential switch, for use with rotating standards, is a problem that has been given a large amount of attention by both manufacturing companies and the committee, and at the present time there are several that give promise of developing into a satisfactory switch that will meet with the requirement of the meter departments. The cooperation of the manufacturing companies has been appreciated by the committee.

Overall vs. secondary testing, has been a live subject for a number of years and while each company has its own method of making tests, it is the opinion of the committee, that overall testing is the most practical where conditions are such that a test of this kind can be made. However, there is a difference of opinion as to where the overall method should begin.

The efficiency in meter testing, on the Pacific Coast, presents a greater problem than in a more congested territory. The economical testing of rural meters offers the most difficulty. The wide use of electric power for irrigation makes it profitable to establish distribution networks covering wide areas, which means that an unusually large number of consumers in remote localities have service for electric lighting and heating, as well as for irrigation power. The efficient handling of a complaint test on a small lighting meter which may be anywhere from five to a hundred miles from meter department headquarters, is no small problem. Such a test must be made when called for, and made as promptly as possible. It will ordinarily be advisable to train power testers in the proper handling of lighting complaint tests. By combining such tests with power tests in the same neighborhood their cost may be materially reduced.

Testing in the larger cities presents fewer difficulties. Such questions as whether the men should report at headquarters in the morning or in the evening, or both morning and evening, and whether an automobile or the street cars

*Meter Committee: W. H. Talbott, chairman; H. C. Abel, J. C. Alberts, J. E. Bridges, J. O. Case, S. L. Knight, C. F. Gilcrist, R. G. Jones, D. D. Smalley, S. E. Dellinger, Otto Knopp, J. M. Morris, L. A. Nott, A. S. Price, M. H. Schnapp, G. H. Searle, J. G. Monahan.

should be used, are best settled according to local conditions. It is usually advisable to have each man handle a definite class of work, such as single-phase complaint testing, polyphase routine, direct current, etc., to improve his efficiency and save carrying different outfits. The location of meters in business districts has an important bearing on the efficiency of testing, and all the influence possible should be used to see that such meters are installed so as to permit a safe, quick test.

The situation regarding the use of Warren clocks has not materially changed since the submission of last year's report. A few interesting developments have been made during the year, however. One noteworthy installation is that of the Georgia Railway & Power Company, of Atlanta, Ga. Because of the far reaching effects of the installation of a clock on this system it offers an interesting example of the possibilities. The clock will control the frequency of approximately 50 per cent of the power used in the entire southeast. The Georgia Railway & Power Company is approximately in the center of the super-zone of the southeast and at present, the following 110,000-volt transmission systems are all operating in parallel:

Alabama Power Company
Tennessee Power Company
Georgie Railway & Power Company
Columbus Electric & Power Company
Central Georgia Power Company
Southern Power Company
Carolina Power & Light Company
Yadkin River Power Company.

With their power plant at Tullulah Falls, in the geographical center of this system, which extends from Selma, Ala., on the south, Nashville, Tenn., on the west, and Raleigh, N. C., on the north, the Georgia Railway & Power Company naturally has to assume a good deal of the responsibility in the smooth operation of the 1,200 or 1,500 miles of line involved. The Warren clock is installed in the load dispatcher's office and by means of it, very close regulation is being accomplished.

The proper size of watt-hour meters for various installations, covers a wide range and it was not possible to make a general investigation in the time available. Also, considerable work has been done in connection with the determining of proper size of meters for motor installations. Therefore, it was decided that this investigation should cover heating and cooking, as far as possible.

Good results were obtained by installing recording ammeters on a number of heating and cooking installations. As this was carried on during the winter months the results should show the maximum current required in each individual case. More work should be done along this line, before any definite recommendation can be made.

The protection of meters from the weather has been taken care of, in the last year or two, in a way satisfactory to those concerned. However, there should be made special mention of the cooperation that has been given by the owner, wiring contractor and box manufacturer. This, we are sure, has been accomplished through the efforts of the meter committee.

The manufacturers are doing all that is possible to make standard equipment, and to design their instruments so that they will meet the requirements of the power companies. The adoption of a removable terminal cover for meters should be accomplished in some way satisfactory to all. Another need felt by the committee, is the use of a standard thread on screws; this may be too expensive to accomplish. However, if it could be done, it would be a great help.

The measurement of kva. and power factor is important, as the utilities are lined up in favor of applying rates which discriminate between loads of high and low power factor; but so far comparatively few central stations have adopted such rates, mainly on account of the lack of proper equipment to take care of the metering. The method of using a so-called "power factor clause" has not worked out satisfactorily, and there seems to be a well defined tendency or conviction that this problem is best solved by making the demand charge on the basis of kva. instead of kilowatt-hours.

In order to provide the necessary metering apparatus, most of the meter manufacturers have been making use of the polyphase watt-hour meter as the basic element. The Westinghouse Electric & Manufacturing Company is developing two different types of apparatus for the above purpose. One is the Sperti-Blecksmith type; the other, the Innes type. The first is made up of two standard polyphase kilowatt-hour meters; one operated as a kilowatt-hour meter and the other operated as a re-active kva.-hour meter. By means of two special registers similar to those in the Westinghouse RA meter, two arms are advanced, one by each meter, each arm carrying a lever. These two levers are tied together at one point. The linear advance of this connection pointer, transmitted through a flexible lead to the demand pointer, is a function of the kva. hours. Through a proper set-back, similar to the one in the RA meters, the kva. demand is recorded. The second, of the Innes type, consists also of two standard kilowatt-hour meters; one operated as a kilowatt-hour and the other as a re-active kva. meter. Through two small driving wheels of equal size the motion of each meter is transmitted to a sphere in such a manner, that if each would drive independently, it would turn the sphere in planes at right angles to each other. A third wheel of identically the same size as the driving wheels is driven by the sphere. This third wheel is at liberty to align itself in the plane of motion of the sphere. If the kilowatt-hour meter were the only moving element, for instance, at unity power factor loads, this third wheel would align itself automatically in the plane in which the sphere is driven by the kilowatt-hour meter, and if the re-active kva. meter were the only driving element, which would occur at zero power factor, this third wheel would automatically align itself in the plane in which the sphere is driven, which is at right angles to the plane in which the sphere is driven at unity power factor. It can readily be seen that, if both driving wheels are operating at different relative speeds, the sphere will revolve at planes which change the angle relative to each other according to the power factor of the load, and it can be shown mathematically that the third, or driven wheel, will revolve at a speed proportional to the kva. or integrate the kva. hours. By means of a standard demand attachment it is possible to derive the maximum kva. for any given period for which a demand attachment is designed.

The Sangamo Company is developing an equipment which consists, also, of two standard polyphase watt-hour meters; one connected as a kilowatt-hour and the other connected as a re-active kva. meter. A little synchronous motor of special design drives a strip paper chart horizontally. Another synchronous motor drives a stylus vertically across the paper chart. The kilowatt-hour meter controls the speed of the stylus and the re-active kva. hour meter the speed of the paper chart; the synchronous motor being provided only to supply the power and to set back the stylus every 15 or 30 minutes, according to the desired demand period. In actual operation, this meter will record on the paper strip vertical lines, the height of which are proportional to the kilowatt demand. The sloping lines connecting the base and top of adjacent vertical lines will be the average kva. The spacing between the vertical lines is a measure of the re-active component or re-active kva. of the power supplied. The cosine of the angle between the sloping lines and the

vertical lines is a measure of the power factor. The indication on a standard meter dial furnishes on one meter the kilowatt-hours and on the other the re-active kva. hours. From the record of such a meter it is possible to obtain all the different quantities involved in the measurement of electric energy.

The testing of large capacity meters presents conditions which are difficult to overcome. The principal source of error is stray fields. This can be eliminated to a certain extent by the arrangement of test leads, etc. Care should be taken when making an installation of this kind, as most of the trouble can be overcome by installing the meter in a proper location.

There seems to be quite a difference of opinion as to the use of oil in meter bearings. The tendency seems to be toward using oil very sparingly or not at all. The principal objections to the use of oil are:

1. Since meters are not entirely dust proof, dust and dirt will enter the meter and have a tendency to collect on the oiled surfaces, gumming up the oil and increasing the friction on the bearings.

2. Owing to the difficulty of obtaining experienced testers it is impossible to be sure of a uniform application of oil and there is danger that much harm may result.

The reasons advanced for the use of oil are:

1. The prevention of rust on steel bearings and gears. The iron oxide formed in the lower bearings of meters acts as a grinding agent and increases the wear on the jewel.

2. The oil floats the dust and oxide particles and prevents their reaching the bearing surfaces.

Most of the companies reporting use fish oils, the most popular being Ezra Kelly's and Nye's oils. Two of the manufacturers report that they are abandoning the use of fish oils, in favor of mineral oils, for the reason that animal oils are more likely to form acid. One company reports the use of Fulcrum Watch Oil, which is a bone oil.

Since the use of oil seems to be for the purpose of reducing oxidation, it is apparently advisable in applying the oil that the film be as thin as possible. For that reason it should be applied, where possible, with an oil damped cloth rather than with a dropper. It is also well that a small piece of lead be carried in the bottle with the oil to neutralize any acid that may be present.

Several watchmakers were interviewed on the subject. It seems to be the unanimous opinion that the useful life of watch oil is from two to four years and that no oil can be relied upon after five years.

In view of the lack of information, we suggest that tests be made by member companies on the Pacific Coast, in order to obtain more information along this line. This could be made available to all companies, and would be helpful for future committee reports.

Through the cooperation of the meter and safety rules committees, several of the State Safety Rules have been modified, so that they are more acceptable to the power companies.

The committee suggests that the following subjects be continued in the next year's work:

Periodic Testing of Watt-hour Meters.

Maintenance of Switchboard Instruments, Meters and Relays; this subject to be divided into Maintenance of Switchboard Instruments and Meters, and Maintenance of Relays.

Potential Switch, for use with Rotating Standards.

The Proper Size of Watt-hour Meters, for various installations.

The Measurement of Kva. and Power Factor.

Use of Oil in Meter Bearings.

The committee was represented at the Milwaukee and New York meetings of the National Electric Light Association, Meter Committee. At New York the suggestion was made that the Pacific Coast have a larger representation on the National Committee. At that time it was thought advisable to recommend to the Association that the coast have more than one member.

An Analysis of Present Rate Schedules

By E. B. Criddle*

THE study of rate problems has been handled by various sub-committees with the members of the rate Research Committee as chairmen of the sub-committees, and is embraced in the following report:

Residence Lighting

Your committee in the study of suitable rates for residence lighting recommends as the most desirable for this class of business a kilowatt-hour rate suitably blocked so as to give the long hour user the benefit of the reduced cost.

As the number of small lighting consumers served by the average central station is much greater than any other class, it is essential to adopt a rate which is favorable from a public policy standpoint. The simple block rate is readily understood by the average customer, and although a rate can be designed for a given case which would approach nearer to the cost of serving a customer of this type whose load factor may vary over a long range, there would be a number of disadvantages to such a rate, the greater ones being as follows:

1. Lack of simplicity, and therefore undesirable from a public policy standpoint.
2. In order to give the high load factor customer the benefit of the lower cost of serving him, it is necessary to either measure, estimate or limit the maximum demand. The installation of a demand meter is not desirable because of the expense.
3. Demand limiting devices are expensive to install and keep in adjustment. Interruption of service when the customer exceeds his demand does not have a very favorable effect upon his attitude towards the utility.
4. Floor area, or the number-of-rooms-method of estimating the demand is not accurate and has the disadvantage of requiring entrance to the customer's premises.
5. Calculating the demand by the number of circuits or number of outlets, while fairly accurate, has the serious disadvantage of discouraging the use of electric service, in that some of the customers in order to keep their demand at a minimum would reduce the number of their outlets and thereby curtail the use of electric energy.

It is the belief of the committee that the top rates for lighting schedule should be similar in form throughout the different sections of the Pacific Coast, so that a customer being familiar with the rates in one section would find similar rates in any other section in which he might reside. With regard to rates for lighting customers in adjacent towns or districts served by the same utility, it is evident that unless there is a great difference in the cost of service, that the same rate schedules should apply. This policy tends to minimize the rivalry between towns and reduce agitation concerning rates.

Commercial Lighting

As outlined in the rate paper last year, generally speaking, "One rate for both commercial and domestic lighting service would be preferable for the reason that in a large number of cases where there is more than one rate applicable to this class of service, the kilowatt-hour use is such that it is very hard to determine just which rate would be the most beneficial for the consumer, and this tends to cause dissatisfaction among the consumers."

However, it would seem to your committee that there is one class of commercial lighting customer which is in an in-

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dividual position—namely, the class consisting of the large office buildings, hotels and department stores—and especially in cases where steam is used for heating purposes and watch engineers are employed to tend the boilers and to take care of the buildings in general. In these cases your committee feels that from the "value of service" theory the rate offered must be attractive. Although a schedule suitably blocked might be designed which would take into consideration the lower cost of serving the large consumer, a wholesale rate with a high minimum is desirable for the following reasons:

a—Although the average cost per kilowatt-hour may be the same under the wholesale rate as under the combination commercial and residence block rate, such a schedule for large users would appeal to a certain class of consumers who consider that their large consumption entitles them to special consideration.

b—The large consumer generally has a higher load factor, a better diversity factor, and a lower percentage of peak responsibility than the residence consumer. Therefore, a better rate should be offered him from both the "cost of service" and "value of service" viewpoints.

Street and Highway Lighting

At the present time there is a very decided tendency toward more and better street lighting. This is probably due to two reasons: the unprecedented growth of this section of our country and the realization by business men that street and highway lighting is one of the community's greatest assets for more and better business. This being true, it is necessary to give very careful attention and much thought to rates covering this class of lighting, so that the cost will not prohibit and still be profitable.

A flat rate wherever practicable should be charged for all classes of street and highway lighting, whether they are systems owned and maintained by the lighting company, such as span and bracket type of fixtures, or ornamental electrolier systems owned by the municipalities or lighting districts. This rate should be so arrived at that all overhead charges, such as interest and depreciation, patrolling, repairs and any other charges incidental to the installation and maintenance of the system, shall be charged off to the burning hours between dusk and midnight, thus making the charge from midnight to dawn only an energy charge, which should encourage all-night lighting.

Wherever practicable, the rate for lighting should include maintenance of the ornamental standards, lamp renewals and globe renewals; in fact, everything necessary to keep the system in first-class condition, obsolescence, of course, being taken care of by the municipality or lighting district, as the case may be.

This not only lends to better care of the system, but also permits proper budgeting so that all costs are taken care of at least a year in advance.

Your committee would therefore recommend that in cases of lighting systems which the company owns, maintains and operates, that the rate should be a flat rate charge per lamp per month, based on the size of the unit, the number of units installed, the type of unit employed and the number of hours burning. This rate should be based upon a dusk to midnight schedule with an energy charge added for each hour the system operates after midnight. This rate is especially advantageous for the reason that municipal and country governing bodies must know the cost of operation of such systems before the system is in operation so that the proper amount of tax may be levied upon the property benefited. In cases where the systems are owned, maintained and operated by the municipalities or lighting districts, usually being of the electrolier type, the rates should be based upon the size of the unit and the hours of burning and should, wherever possible, be a flat rate. Your committee woul drecommend that wherever possible that the company make a rate in which it will maintain the systems, furnishing lamp renewals and keeping the posts in good order; with the exception, however, of the underground system, which should be left to the municipality or lighting district to maintain.

Electric Signs, Flood and Billboard Lighting

Electric signs, flood and billboard lighting can all be grouped under one head, as in all of these cases energy is used principally for advertising purposes. Electric signs and billboard and flood lighting are oftentimes used at a considerable distance from the customer's place of business. It is the opinion of your committee that a flat rate schedule, optional with the regular meter rate, should be given, which would cover all this type of lighting, such schedule to be based upon the operation of this type of lighting from dusk until 12:00 p. m. each and every night. The flat rate given should be a flat charge per watt per month of connected load. Your committee's belief is that the rate after 12:00 p. m. should be considerably lower in most cases than that from dusk to 12:00 p. m. There are a number of reasons why this should be offered upon a flat rate basis, some of these being:

1. The advertiser must usually know the cost of service to his sign or billboard in terms of dollars per month before he is willing to enter into a contract.
2. By placing this service on a flat rate basis, the service can be given in the cheapest possible manner, in that it is not necessary for the company to read or install meters.
3. By placing this on a flat rate basis the company may place in connection therewith a patrol charge, and as the electric signs, flood or billboard lighting are usually a considerable distance from the customer's place of business, this patrol charge may take care of his turning on and off.

Your committee also would recommend that a service charge be made in connection with this flat charge, such charge to take care of the cost of maintaining and renewing burned out lamps.

Domestic and Commercial Cooking and Heating

Generally speaking, the power companies are approaching a period in growth when the expansion of business beyond the rate of normal community growth means the development of new fields, and as such the cooking and heating business is attracting considerable attention. As a consequence, no little consideration has been directed towards the subject of suitable rates for this class of business. Any discussion of rates, however, first involves some study of the comparative value and ultimate possibility of the cooking and heating load.

Such a study is aided by the comparison of the domestic cooking and water heating combination load with the domestic lighting load. The statistical figures for the year 1921 and 1922, as compiled by the committee, show that the average domestic lighting consumer uses about 28 kw.-hr. per month, while the average cooking and water heating consumer uses about 310 kw.-hr, or 11.1 times the consumption of the domestic lighting consumer. Separate domestic installations of electric ranges and electric water heaters average monthly consumptions of 151 and 230 kw-hr., respectively, or 5.4 and 8.2 times the consumption of the domestic lighting consumer. Obviously, almost every domestic lighting consumer is a possible cooking and water heating prospect. Therefore, the ultimate possibility of this particular phase of the load becomes more apparent when the ratio of 11.1 is applied to the domestic lighting load of a power company. The approximate result may be here illustrated by assuming that the domestic lighting load of a power company is, say, 2 per cent of its total load, in which case the ratio of 11.1 would mean a possible increase of 22.2 per cent of its total load.

But residence or home heating, in addition to being insufficiently developed to provide representative statistics, assumes the difficulties of a variable and seasonal load. It becomes more difficult, therefore, to estimate the future possibilities of home heating, which likewise is true in a measure of commercial cooking and heating. It is logical to assume,

however, that these loads, from the standpoint of consumption, are of no less importance than the domestic cooking and water heating load.

From the power companies' standpoint the four principal factors entering into the question of cost of service of domestic cooking and heating are: the size of load, necessary investment, load factor and peaks. The first and second might be termed uniform, the third variable, and the fourth favorable. That is to say, the size of load is uniform in that the variations between the smallest and the largest installations are not so great as to necessitate rate differentials or to cause material variations in the necessary investment in services, while the load factors of installations are variable to about the same extent that domestic lighting is variable. The cooking and heating load is generally considered an off-peak load. It becomes apparent, therefore, that the most suitable form of rate for this class of service is the simple block schedule type of rate with sufficient minimum and differential to take care of the usual variations in consumption—a modified form of the schedule which is now quite generally in effect in central California. Simplicity of rate is popular with the consumer because it is easy to understand; it is advantageous to the power company because its application is easily explained.

A commission decision permits a more general application of the general power schedule to the commercial cooking and heating business. This should stimulate the use of electricity for that purpose, especially among consumers with a high load factor, and a connected load of 25 kw. or more. As this schedule is optional with the domestic cooking and heating schedule, the latter will prove more advantageous to the small consumer, but for loads of 25 kw. or more the general power schedule will run much lower than the commercial cooking and heating schedule, the reduction depending, of course, upon the size of load and the load factor. It would appear, therefore, that the general tendency is toward rates that will lead to a more rapid growth in load and at the same time produce satisfactory return for the power companies.

Rates for Industrial Power and Heating, Electro-Chemical Load and Electric Furnaces.

The above classes of load may all be characterized as heavy power service, involving bulk delivery of large blocks of power at a few locations, rather than small deliveries to a great number of consumers scattered over a distribution network.

Industrial power loads operate on a great variety of load factors; the power factor of delivery may range from 50 per cent to unity, and the usage is chiefly confined to the hours from 7 a. m. to 6 p. m., although certain industries may operate all night.

Industrial heating loads will tend to operate on a high load factor to obviate the losses incident to the cooling down of ovens, etc., while the power factor of delivery is likely to be close to unity. Electro-chemical industries are still more likely to operate at high load factor and power factor. Electric furnaces, for steel melting chiefly, are, on the contrary, liable to have very poor power factor, particularly early in the heat, as well as heavy momentary demands.

Under these circumstances, the fundamental rate question which arises is as to the relative desirability of separate rate schedules for these various classes of load, as compared with a single schedule, with proper adjustments, to cover all these loads.

Considered from the cost of service standpoint, it at once becomes apparent that no logical reason exists for a multiplication of schedules, for it is certainly self-evident that the cost of serving an industrial power load would be exactly the same as the cost of serving an electro-chemical load, provided the two loads had similar characteristics. If the characteristics were different, the single schedule would still be appropriate if the variation in charges under the schedule kept pace with the variation in cost, due to the change of characteristic.

The load characteristics involving differences in cost, and which would have to be covered by rate differentials in any schedule to satisfactorily cover the classes of load mentioned, are as follows:

1. Size of load: the larger loads are cheaper to supply, per unit, than the smaller.
2. Load factor: loads having high load factor being entitled to a lower rate.
3. Power factor: loads having high power factor being entitled to a lower rate.
4. Voltage: ownership of transformers by the consumer would entitle him to a rate differential.
5. Time of principal demand: loads which habitually keep off the peak being entitled to a consideration.

The ordinary "demand and energy" form of power schedule takes care of the variations due to size of load and load factor. The schedule may be of either of the two general forms illustrated in Appendices A and B, it being possible to make these forms practically identical in resultant charge, over the ordinary range of load factor.

Power factor requires special treatment, as it has not been generally covered by rates up to the present time. Various types of power factor rates have been proposed and used by different companies, including the use of kva. demand instead of kw. demand; the correction of the demand to a certain standard power factor as .80; special meters recording the kw.-hr. at normal rate, and, adding the reactive-component kva. hours at a reduced rate, and many other variations. After much study one of the larger companies of the state prepared and submitted as a proposal to the Railroad Commission in connection with a recent rate case the form of power factor schedule shown in Appendix C.

The general idea of this schedule is to reward good power factor and penalize poor power factor, leaving the regular rates unaffected for a range of normal power factor. The power factor on which the schedule charges are based is practically the average during the consumer's operations. The schedule is a rider to apply as a correction to regular power schedules and affects only those large consumers where correction of power factor by the consumer is economically feasible.

The question of voltage of delivery, which really means ownership of transformers, can readily be handled by a differential in the rate, and this is now incorporated in various schedules in use by many of the companies so that it represents nothing new.

The remaining question of a differential for off-peak loads has not been so extensively recognized. The off-peak period of most companies is between the lighting peak of the evening and the resumption of the industrial load in the next morning—for example, between 11 p. m. and 6 a. m. It may be desirable to make some discount in the demand charge for the power used within this period. One possible method would be to discount by a fixed percentage the entire charge on energy used within this period, but as this would involve duplicate metering equipment, together with time switches to transfer the load between the meters, it becomes complicated and hence undesirable. Another alternative is to discount the demand occurring off peak, either to ignore it entirely or to take only partial account of it. The latter is the method suggested in the rate schedule forms shown in Appendices A and B. This method requires the use of either curve drawing demand meters or a time switch to cut out the demand meter over the off-peak period, and should therefore only apply in cases of large consumption.

It thus appears that it is quite feasible to handle all the factors affecting cost of service to industrial power and heating, electro-chemical load and electric furnaces, by means of a single schedule applicable to all, though such a schedule will be somewhat complicated. The complication is not believed to be serious for the large loads considered, for in most of these cases trained engineers are employed by the consumers, and the explanation of the schedule becomes possible.

If applied to very small loads the complications of adjustment for all the various conditions becomes intolerable, and only differentials for size of load and load factor should be recognized in the rate.

A careful inspection of the alternative schedules shown in Appendices A and B, together with the power factor rider of Appendix C, will show that all the conditions laid down in the discussion have been compiled within these rates. The power factor rider, though shown separately, could of course be incorporated into either rate A or B, so that a single schedule would cover all the classes of service mentioned.

The alternative to a single basic rate with adjustment factors to cover conditions is a multiplicity of schedules, one for each class of service. These rates would then have to be hedged about with conditions to avoid abuse. It appears that the reduction in number of schedules and the policy advantage of uniformity of treatment of consumers would amply justify the use of the single schedule.

So far the discussion has been confined to the study of rate forms based on the cost of service theory. It may, at times, be necessary to recognize the effect of possible competition with isolated plants on the consumer's premises, either Diesel engine or steam engine. The rate forms suggested are elastic enough to permit adjustment for these conditions, their form corresponding in general to the shape of the cost curves existing with the private plants.

The granting of reduced rates during the development period of an industry is sometimes urged. This is quite hazardous, as the industry is not established on a firm basis, and is also likely to consider that it has a vested right in the reduced rate.

Rates for Industrial Power and Heating, Electro-Chemical Load, and Electric Furnaces.

Form of Schedule—"Appendix A"

(This schedule is quoted for **form only** and is not intended to be exact as to rates.)

Applicable only to alternating current electrical energy supplied at not less than 2,200 volts.

Rate (A)—

Service at 2,200 volts up to and including 25,000 volts.

Demand Charge:

First 250 kw. or less of maximum demand — $500 per month.
Next 250 kw. of maximum demand—$1.25 per kw. per month.
All over 500 kw. of maximum demand—$1.00 per kw. per month.

Energy Charge (to be added to the Demand Charge):

First 150 kw.-hr. per kw. per month @ .9c per kw.-hr.
Next 250 kw.-hr. per kw. per month @ .8c per kw.-hr.
All over 400 kw.-hr per kw. per month @ .75c per kw.-hr.
Provided that in all cases at least the first 100,000 kw.-hr. of energy shall be charged at the .9c rate.

Rate B—

Service at company's standard transmission line voltages in excess of 25,000 volts.
The rate is the same as that set forth under Rate (A) above, except the demand charge shall be decreased 10 per cent.

Special Conditions:

(a) The maximum demand in any month shall be the average kilowatt input in the 15-minute interval in which the consumption of electricity is greater than in any other 15-minute interval in the month. For rapidly fluctuating loads, the company may base the consumer's maximum demand upon a 3-minute instead of a 15-minute interval.

(b) No demand occuring any night within the period from 11 p.m. to 6 a. m. will be considered in determining the demand charge; provided, that in no case shall the demand be taken as less than 25 per cent of the connected load, under this rule.

(c) Discount or penalty for power factor shall be as provided in rider.

Rates for Industrial Power and Heating, Electro Chemical Load, and Electric Furnaces

"Appendix B"—Alternative Form of Schedule

(This schedule is quoted for **form only** and is not intended to be exact as to rates.)

Applicable only to alternating current electrical energy supplied at standard voltages, in accordance with company rules, from 110 volts to 2,200 volts.

Rate: Connected Load or Demand	Rate per kw-hr. for monthly consumptions of 1st 60 kw-hr. per hp.	Next 60 kw-hr. per hp.	Next 60 kw-hr. per hp.	All over 180 kw-hr. per hp.
2– 9 hp.	4.0c	2.1c	1.3c	1.2c
10– 24 "	3.6c	2.0c	1.3c	1.1c
25– 49 "	3.1c	2.0c	1.3c	1.0c
50– 99 "	2.6c	1.7c	1.2c	1.0c
100– 249 "	2.2c	1.5c	1.1c	.9c
250– 499 "	2.1c	1.3c	1.0c	.9c
500– 999 "	2.0c	1.2c	1.0c	.8c
1,000–2,499 "	1.9c	1.1c	.9c	.8c
2,500 and over	1.8c	1.0c	.9c	.8c

Minimum Charge—

Connected Load Basis: $1.00 per month per hp. connected for the first 50 hp., plus $0.60 per month for each hp. in excess of 50, but not less than $2.00 per month.
Maximum Demand Basis: $1.00 per month per hp. of measured maximum demand, which shall not be less than 20 per cent of the connected load, and in no case less than $50.00 per month.

Special Conditions—

(a) Consumers having a total connected load in excess of 50 hp. may, upon request, have the rate and minimum based on maximum demand instead of connected load.

(b) The maximum demand in any month shall be the average kilowatt input in the 15-minute interval in which the consumption of electricity is greater than in any other 15-minute interval in the month. For rapidly fluctuating loads, the company may base the consumer's maximum demand upon a 3-minute instead of a 15-minute interval.

(c) For loads exceeding 300 hp. connected, and operating on the demand rate of this schedule, the following shall apply:
No demands occurring any night within the period from 11 p.m. to 6 a.m. will be considered in determining the demand charge; provided, that in no case shall the demand be taken as less than 25 per cent of the connected load, under this rule.

(d) Discount or penalty for power factor shall be as provided in rider.

Note: Discount for consumer ownership of transformers, if desired, could be applied in some such form as a discount from the monthly bill of $0.10 per hp. of connected load for the first 200 hp., plus $0.05 per hp. for all over 200. This should be limited to the larger loads, if included at all.

Rates for Industrial Power and Heating, Electro-Chemical Load, and Electric Furnaces

"Appendix C"

Non-optional Power Factor Rider, to be attached to regular schedules.

Power Factor Discount and Penalty—

Applicable to all alternating current power service supplied under standard schedules of the company, where the connected load exceeds 500 hp.

Territory—

Applicable to all territory served.

Power Factor Determination—

The average power factor, weighted in proportion to consumption, shall be determined monthly by means of "Reactive Component Kilovolt-Amphere-hour Meters" used in connection with the usual kilowatt-hour meters; by means of two single-phase kilowatt-hour meters for measurement of 3-wire, 3-phase power load; or by such other suitable means as the company may determine.

Power factor corrective apparatus when used by the consumer, shall be so installed that it is effective only at times when the consumer's power load is in use; and discount shall be made for power factor correction during only those periods when the consumer's power factor is between .85 lagging and .95 leading, same to be determined by the company by appropriate tests. No discount or penalty under this schedule shall be applied for months when the kilowatt-hour consumption is less than 10 per cent of the maximum kilowatt-hour monthly consumption recorded for the load within the preceding 12 months.

Based on the average power factor determined as above, discounts or penalties, applied to the monthly total bill including minimums, shall be charged in accordance with the following rate table:

Rate: Average Power Factor	Discount or Penalty	Discount or Penalty on Monthly Bill Percent of Total Bill: For that part of bill up to $2.00 per (a) hp. of Maximum Demand per Month	For that part of bill exceeding $2.00 per (a) hp. of Maximum Demand per Month
Above .97 to 1.00	Discount	2.50%	1.25%
" .94 but not exceeding .97	"	2.00%	1.00%
" .91 " " " .94	"	1.50%	.75%
" .88 " " " .91	"	1.00%	.50%
" .85 " " " .88	"	.50%	.25%
" .70 " " " .85		None	None
" .65 " " " .70	Penalty	1.00%	.50%
" .60 " " " .65	"	2.00%	1.00%
" .55 " " " .60	"	3.00%	1.50%
" .50 " " " .55	"	4.00%	2.00%
.50 and less	"	5.00%	2.50%

(a) For schedules not requiring maximum demand measurement, 75 per cen of the connected load shall be used.

Annual Minimum—

Where an annual minimum charge is involved, the discount or penalty applicable to said minimum shall be based on the above table using the average power factor, weighted in proportion to consumption for the entire year.

Oil Field Service

This service generally implies the actual service to oil leases for the purpose of operating equipment used for drilling and pumping oil wells, operating and gathering pumps, leased line pumps, and dehydrating plants, in connection with the production of oil.

In contemplating a suitable rate for the application to this class of business, it is well to remember that in many cases natural gas is available in sufficient quantities to present strong competition from the standpoint of economical operation, and as this is generally considered a byproduct in the production of oil, the tendency on the part of the producer is to assume that such fuel may be considered as having no bearing on the operating cost.

Fortunately, the general character of use of electric power in the oil fields is such as to produce a fairly high load factor, and consequently, lends itself more readily than other classes of power to the application of a straight kilowatt-hour charge. This type of rate being the most simple in form and application, might be said to be the most suitable form of rate in oil field service.

While, as stated before, the oil field load factor is fairly good, the power factor is notoriously poor, being generally between 40 per cent and 60 per cent, and this phase must be taken into consideration also in determining the rate to be applied.

As a low power factor not only affects service, in poor regulation, causing variable voltage and unsatisfactory power service, but also means increased cost to the central station company in operating costs and fixed charges on additional investment, it can be readily seen that measures should be taken to in so far as possible correct this condition.

In bringing the power factor to near unity, as stated before, certain corrective measures must be taken, and while the consumer must necessarily pay directly or indirectly the cost of obtaining this result, it would appear that in the case of general use of power for oil field service it would be more practical for the central station company to bear the burden in correcting this condition.

In considering the possibility of the consumer being required to install apparatus which would not operate lower than a given power factor, it must be taken into consideration that the character of use generally made of this class of service requires the installation of motors of such size and type which would not permit the use of synchronous in substitution for inductive motors. In general, the motors are of a relatively smaller rated capacity than is obtainable in synchronous motors, as the highest rating on the average pumping motors is not to exceed 30 to 40 hp.

The fact that synchronous motors are not obtainable in sizes less than 40 hp. and that the cost of such an installation would be increased approximately 100 per cent over that of induction type, would apparently make this substitution out of the question.

Considering the fact that oil field business is in a manner localized and also that where such a large number of motors of relatively small capacity are in operation, the diversity factor would be pronounced, it would appear that the central station can assume the burden of correcting low power factor much more economically than can the individual consumer.

The methods employed by central station companies in accomplishing this result are so well known that no discussion is necessary.

Obviously, the cost of correcting this condition is definitely reflected in the rate chargeable to this class of service, but by paying indirectly in this manner, the cost to the consumer is not only much less but more equitably divided than would be the case should each consumer be required to bear the burden of such corrective measures individually.

Agricultural Power Service

By agricultural power service is generally implied service to motors used for the irrigation of lands, silage or feed cutters, machine or blacksmith shops on the farm (where no commercial business is done), milking machines, cream separators, pumping motors for domestic water supply, and any other utilization of energy applied in connection with the farming business. In California and particularly in the San Joaquin and other central valleys, the principal use of power in the farming industry is for the purpose of irrigation, and necessarily this class of service is the determining factor in making a rate applicable to general use of power service in agriculture.

In the evolution of rate making it is probable that with the exception of lighting service, there have been more changes in rates applicable to agricultural power, than in any other class of service. This is, no doubt, due to the fact that the use of electricity in agriculture is of comparatively recent date, and as there was no precedent established as a guide to rate engineers, up to very recent years, the rates employed have been largely experimental.

It must be taken into consideration that the character of use is as applied to agriculture so diversified, that no set formula can be applied which will result in a rate that would be equally advantageous under all conditions. It must be assumed that seasonal use of power, crops produced, soil and general climatic conditions are all factors in determining a rate which would be applicable with any degree of fairness as between consumers operating under different conditions and whose power requirements are widely divergent.

One of the early types of schedule was the flat seasonal rate. As these were based on high load factor conditions that were largely presumptive, and in many instances could not be attained, it was somewhat impractical in general use and was not readily conducive to the wide distribution of power service.

As an entirely opposite type of schedule in its effect would be the straight kilowatt-hour charge. On account of the large diversity of use as mentioned before, this type of rate is conceded as being impracticable for general utilization. As where in the case of the seasonal flat rate, the consumer whose use is more nearly continuous might be unduly favored, with the resultant effect of discouraging the business offered by the consumer whose use might be for shorter periods or intermittent in character.

The straight kilowatt-hour charge, on the other hand, has the directly opposite effect of penalizing the consumer whose use would be more nearly continuous, and favoring the more unprofitable short term or intermittent business. Therefore, with these phases in mind, it would appear that a proper schedule or one which more nearly approaches the situation would be a schedule, which while keeping a degree of uniformity in charges for service, more nearly maintains a relation between the individual use made of the service by the consumer and the cost of service to the central station. It is generally conceded that this result is more nearly approached in the application of an annual kilowatt-hour rate, properly blocked as to kilowatt-hours, and the charges for same, so that a more equal relation between the various uses made of the service may be maintained. Such rate may be in the form of an annual demand charge to which is added a relatively low kilowatt-hour charge, the demand charge to be divided into equal parts and made payable over a period which would be most comparable to the seasonal use of the service.

An optional method of obtaining approximately parallel results is the application of relatively higher rates to the kilowatt-hour blocks, with an annual cumulative charge.

These two methods are illustrated by the following schedules which are being applied on the system of one California utility and are comparable to schedules for this class of service on other utility systems:

Rate:	For Connected Loads of 2 hp. to 9 hp.	10 hp. to 24 hp.	25 hp. to and Over
Demand Charge per hp. per year.....	$14.00	$13.00	$12.00
Plus following Energy Charge per hp. per year:			
First 2,000 kw-hr..... @	1.7c	1.6c	1.4c
Next 2,000 " ..... @	1.4c	1.4c	1.2c
Over 4,000 " ..... @	1.2c	1.2c	1.1c

Rate: Annual Consumption per hp.	Rate per kw-hr. for Connected Loads of 2 hp. to 9 hp.	10 hp. to 24 hp.	25 hp. and Over
First 500 kw-hr.....	3.6c	3.4c	3.2c
Next 500 "	2.6c	2.4c	2.0c
Next 1,000 "	1.7c	1.6c	1.4c
Next 2,000 "	1.4c	1.4c	1.2c
All over 4,000 "	1.2c	1.2c	1.1c

MINIMUM CHARGE:
First 10 hp. @ $15.00 per hp. per year, but not less than $30.00 per year.
Over 10 hp. @ $12.00 per hp. per year, but not less than $30.00 per year.

The arguments which have been put forth in opposition to this form of rate are seemingly more or less superficial and are largely based on the consumer's inability to readily understand basic principles involved. As the average consumer is not acquainted with the principles of rate making, any change in form might present such an argument, and it would seem that these objections could be overcome by proper education and salesmanship.

While this discussion is based largely on personal experience and observation, it would appear to be a reasonable presumption that the form of schedules suggested would at least be an approach to the desired result.

Service to Municipalities

Electric service to municipalities by central station companies is of two classes, namely, retail service and wholesale service.

The first of these, or retail service, is the most general, and covers service to public buildings, both light and power, the lighting of streets, roads and parks, power for the operation of city water works, and sewerage systems. In short, it covers all that service required by a municipality for municipal purposes, this power being distributed and delivered to the point of use by the central station company.

The second classification, or wholesale service, covers generally the supplying of power in bulk or wholesale delivery to the municipality, for distribution by the latter to its citizens and for its municipal uses.

Retail service to municipalities is ordinarily more desirable than wholesale service, inasmuch as the distribution of electricity to the ultimate user is the proper function of the central station, and is a work it is eminently fitted to perform. In retailing to municipalities, service should be furnished on the same basis as to other consumers receiving like service. Street and road lighting presents a special class of business peculiar to municipalities, and should of course be so treated. This may be handled either by furnishing the electric energy only or by furnishing the complete service, including the installation of the system in part or in whole, the maintenance and operation of same and the making of lamp renewals.

It is believed that in general the most satisfactory arrangement is for the central station to furnish the complete service and to charge therefor certain definite flat rates, these rates to cover the electric energy supplied, the maintenance, operation and depreciation of the lighting system and a reasonable return upon the capital invested by the central station in the lighting system.

In some instances, where ornamental posts or other special features are desired, it may work out better for the municipality to own and maintain such parts of the system. One of the principal advantages in having the complete service rendered by the central station is that it has within its control, all the facilities for rendering a complete service and that neither its revenues or reputation can suffer from the failure of the municipality to furnish that part of the service for which the municipality is responsible, as may be the case where the central station is not furnishing the complete service. The matter of rates for this service is discussed elsewhere in this report.

In considering the wholesaling of power to municipalities for distribution and resale by the latter to its citizens for general lighting and power uses, the matter of rates is of highest importance, not only with reference to a proper charge for the service rendered, but also in regard to the rates at which such power can be resold by the municipality. This service should generally pay a higher rate than the regular power schedule inasmuch as it is a load representing a composite of a large number of individual loads and so has taken advantage of the diversity which would ordinarily fall to the central station. In other words, it would ordinarily have less diversity with other loads than the general power loads for which the regular schedules are made and consequently should pay a higher rate. Again, the effect of this rate upon the retail rates to be charged by the municipality should be given consideration.

The retail rates of central stations are nearly always uniform as between communities and usually in rural territory as well. It is of course obvious that the cost of distribution varies as between these different communities and also in rural territory, being higher in the rural territory and in the communities having more scattered load conditions. It is also obvious that a favorably situated municipality can distribute power within its boundaries at less than the average cost and if power is sold to it at wholesale at or below the average wholesale cost, it can retail it at less than the retail price of the central station, which brings about an unfair comparison and unfavorable comment. The central station could do the same thing if it were permitted to charge higher rates to those communities or districts where the distribution costs were higher, but it is not permitted, nor is it desirable to do so, and in the interest of sound public policy it is believed that this is a good arrangement.

In the interest of fairness, however, the wholesale rate to municipalities would in some measure reflect this condition so that those consumers located in favorably situated communities supplied by municipal distribution systems should bear the same relative burden in helping keep down rates in less favorably situated localities as similarly situated consumers supplied by the central stations are required to do.

Competitive Installations

The report of last year's committee, covering cost of various forms of power, seemed to outline particularly plants of larger size or higher load factor than are generally encountered in the majority of cases where central station energy enters into competition with steam plants of from 1,500 to 5,000-kw. capacity, but in such cases the prospective consumer usually has at least a fairly accurate knowledge of the actual cost of operation, and except in cases where the fuel is a byproduct, and the cost of disposing of this byproduct also enters into the equation, it is usually quite apparent that hydroelectric central station energy is cheaper than other forms of power. This can be readily seen by reference to the "average cost per kw-hr." as shown in comparisons made in the 1921 report of the committee.

Generally speaking, the greatest advancement will be made in the central station field by extending the service to the greatest number of consumers and industries, and this means a more active campaign in the fields covered by small

units of 50 hp. and under used in agricultural sections, and plants in industrial territory where single unit installations of 400 hp. and under may be replaced by individual motor drive or group drive.

The committee's report for 1921 covers steam and Diesel oil engine installations of 1,500 to 5,000 kw., Diesel oil engines of 250 kw., semi-Diesel oil engines of 50 and 100 hp., and a natural gas engine of 45 hp. This covers practically all types of plants entering into competition with Pacific Coast central station companies except the small steam plants of approximately 400 hp. or less that are sometimes operated by irrigation companies and in industrial territory. To make the list of types more complete, tables are hereto appended, outlining the cost of operation of a 400-hp. steam installation using a Corliss compound engine operating condensing 18 hours per day at full load for 6 months per season, standing idle for the balance of the year. This class of plant will be found in agricultural fields. This sheet also covers a plant of the same size and type, but operating non-condensing for 8 hours per day and 300 days per year. This class of installation will be found in industrial territory.

It must be remembered that comparative costs as outlined on paper are not representative of actual average conditions as found in the field except in the case of the more reliable types of steam plants that are in use under high load factor conditions, and even in these cases physical depreciation only is considered in setting up the costs of operation on paper, while in actual practice functional depreciation almost always causes replacement many years before physical depreciation has ended the useful life of the unit. This is particularly true on the Pacific Coast where development has been so rapid.

Except in instances where the installation is of sufficient size and the yearly load factor is high enough to justify the employment of competent engineers to operate the plant, the cost of operation of a gas engine as set up on paper is misleading and entirely unreliable.

The cost of fuel is only a small portion of the total cost of operating an oil or gas engine, and the engine manufacturer and the prospective consumer who has not had previous experience with gas engines, will not accept the rates of depreciation, cost of repairs and cost of attendance that we all know are found in practice, when these items are set up on paper.

The man who has had years of experience in operating a gas engine as a side line to raising a crop, readily appreciates the value of electric service and it should be remembered that when we are selling electric service we are offering an entirely different service than the engine salesman is offering.

A favorite "outdoor sport" of the engine salesman is to offer to replace a consumer's motor with a gas engine and allow the consumer to pay for the engine with the "saving in cost of operation." What he really means is the difference between the fuel bill and the bill for electric energy. In such case the customer should secure from the engine salesman a written guaranty of the saving to be effected after proper allowance for maintenance, depreciation, interest and labor.

When the agricultural consumer is passing through a period of low markets for his product, this often sounds very alluring, but this is what results:

The seasonal hours of operation of the average plant in the agricultural district are such that the difference between the fuel bill and the bill for electrical energy will not pay for the engine in less than five or six years, and this means that the consumer will be paying the same amount in money per month for his power during this five or six year period as he paid under electric operation, the only difference being that part of the money goes to the party supplying the fuel and the balance to the engine salesman. In addition to this, the consumer has the cost of repairs and annoyance of operating the engine for six years, if it lasts that long, and then finds his motor gone and a worn-out gas engine on his hands.

A number of years ago one of the large utility companies of the Pacific Coast replaced practically all of the gas engines under its lines and at that time, distillate was six cents per gallon and electrical energy was sold for approximately two cents per kilowatt-hour.

It has been found that the thermal efficiency of gas engines as actually tested in the agricultural districts of the Pacific Coast averages between 17 per cent and 18 per cent, and the cost of fuel per indicated horsepower was about $.006. With natural gas of 1,100 B.t.u. per cu. ft. and at a rate of 45c. per thousand cu. ft., the cost per indicated horsepower would be approximately $.0053.

From the above, it is apparent that the cost of natural gas in California at this time is little less than the equivalent of distillate at six cents per gallon, and the average rate per kw-hr. earned by agricultural consumers is less than two cents per kw-hr., so it should not be difficult to compete with natural gas engine drive if the salesman can make the prospective consumer see the actual facts regarding gas engine operation. These cases are matters of salesmanship rather than engineering.

The question of small gas engines for driving machinery in industrial plants need not be considered, as such matters as fire hazard, lack of flexibility, loss of production, loss of labor, etc., are so well known by the managers of industrial plants that such drives are seldom given a thought.

POWER COSTS, SMALL STEAM PLANTS

Case I.

A 400-hp. Compound Corliss Engine, operating and condensing at full load for 18 hours per day for six months in the year, and idle for the balance of the year. Engine direct connected to 300-kw., 2,200-volt, 3-phase generator.

Cost of plant complete, including boilers, engine, generator, etc., $190.00 per kw.		$57,000.00
Fixed charges on plant, @ 15%		8,550.00
Kw-hr. generated annually, 972,000		
Fixed charges per kw-hr.	$.0088	
Fuel cost per kw-hr. with oil @ $1.25 per barrel	.0106	
Labor cost per kw-hr.	.0031	
Repairs, supplies, etc., per kw-hr.	.0031	
Total cost per kw-hr. generated	$.0256	

Case II.

A 400-hp. Compound Corliss Engine, operating non-condensing at full load for 8 hours per day, 300 days per year, direct connected to 300-kw., 2,200-volt, 3-phase generator.

Cost of plant complete, including boilers, engine, generator, etc., $175.00 per kw.		$52,500.00
Fixed charges on plant, @ 15%		7,875.00
Kw-hr. generated annually, 720,000		
Fixed charges per kw-hr.	$.0109	
Fuel cost per kw-hr. with oil @ $1.25 bbl.	.0114	
Labor cost per kw-hr.	.0050	
Repairs, supplies, etc., per kw-hr.	.0042	
Total cost per kw-hr. generated	$.0315	

SECURING PLANS FOR ELECTRIC HOMES IN JAPAN

A campaign designed to increase the use of electricity in Japan is being waged in that country at present. The power companies there, both privately owned and those operated by municipalities, are cooperating with electrical manufacturers in an effort to educate the people to the use of new labor-saving devices.

As a means of securing interest in the drive, a contest is being held to secure designs for homes in which electricity can play the most important part in the most efficient manner, in the home of moderate means. These designs when submitted are in reality plans for electric homes. The winning plan will undoubtedly be given considerable publicity throughout Japan and will serve to give the residents of the island country a better idea as to how electricity may be utilized in their homes.

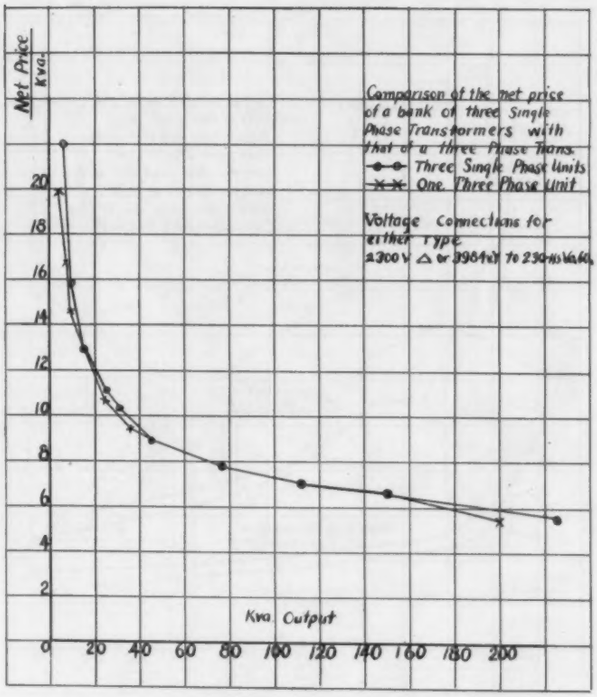

Net Price
Kva.
Comparison of the net price of a bank of three Single Phase Transformers with that of a three Phase Trans.
Three Single Phase Units
One Three Phase Unit
Voltage Connections for either type
2300 V Δ or 3984 Y to 230-115 V Δ 60~
Kva. Output
0 20 40 60 80 100 120 140 160 180 200
2 4 6 8 10 12 14 16 18 20

Fig. 1.—Comparison of net price, 2,300-volt type

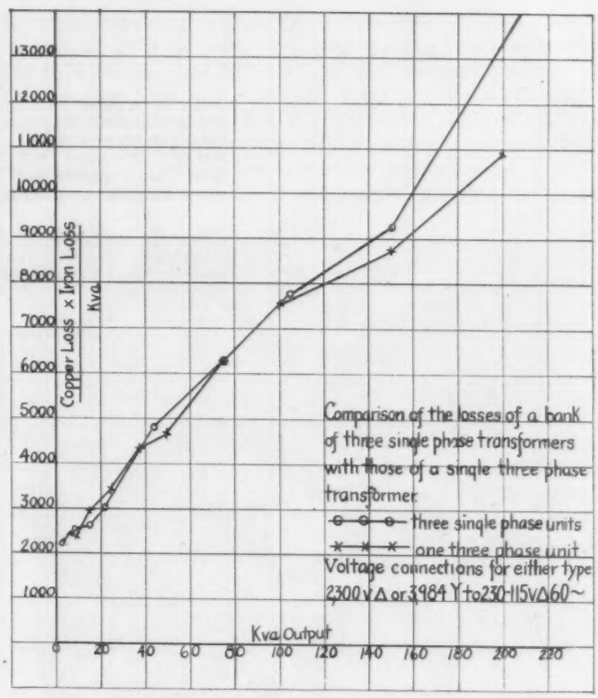

Copper Loss + Iron Loss
Kva.
Comparison of the losses of a bank of three single phase transformers with those of a single three phase transformer
three single phase units
one three phase unit
Voltage connections for either type
2300 V Δ or 3984 Y to 230-115 V Δ 60~
Kva. Output
0 20 40 60 80 100 120 140 160 180 200 220
1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000 13000

Fig. 2.—Comparison of losses, 2,300-volt type.

Three-Phase Vs. Single Phase Transformers for Distribution Power Service

By E. Y. Porter*

THIS subject has been very fully discussed in written communications adressed to the chairman of the sub-committee, as well as in oral discussion at each of the meetings of the apparatus committee. It appears that there is still a considerable difference of opinion among engineers, although the tendency seems to be in favor of 3-phase transformers for strictly power work. The San Diego Consolidated Gas & Electric Company, Southern California Edison Company and The Southern Sierras Power Company are definitely committed to the policy of using 3-phase transformers for distribution power service on lines of 11,000 to 33,000 volts, in sizes up to 300 kva., and The Southern Sierras Power Company is using 3-phase transformers on 2,300-volt circuits, in addition to higher voltage circuits. The San Joaquin Light & Power Corporation are definitely opposed to the use of 3-phase transformers, preferring the use of three single-phase transformers in each bank, frequently installing one transformer of larger size to take care of heating and lighting loads in conjunction with power service. The Pacific Gas & Electric Company has made only a very limited use of 3-phase transformers and prefer generally the use of single-phase, although they appear to look more favorably on the use of 3-phase under certain conditions. The Bureau of Power and Light of the City of Los Angeles has not used 3-phase transformers for power distribution, inasmuch as its service is nearly all within urban districts.

One of the important features of this class of service brought out in the discussion is the increasing importance of electric lighting and heating service in conjunction with power service in the rural districts, it appearing that in many instances, particularly in the San Joaquin Valley, this domestic service amounts to from 50 per cent to 100 per cent of the power load. This fact, coupled with the fact that the service

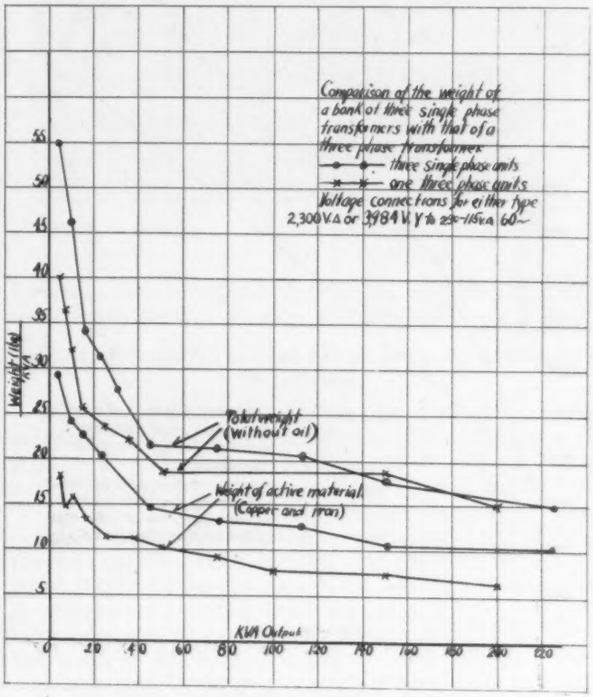

Comparison of the weight of a bank of three single phase transformers with that of a three phase transformer
three single phase units
one three phase units
Voltage connections for either type
2,300 V Δ or 3984 V Y to 230-115 V Δ 60~
Weight (lbs.) / kva.
Total weight (without oil)
Weight of active material (Copper and Iron)
KVA Output
0 10 20 30 40 50 60 70 80 90 100 110 120
5 10 15 20 25 30 35 40 45 50 55

Fig. 3.—Comparison of weight, 2,300-volt type.

*Distribution Transformer Sub-committee of Apparatus Committee: E. Y. Porter (chairman), N. B. Hinson, S. J. Lisberger, E. A. Quinn, C. A. Heinze, L. M. Klauber.

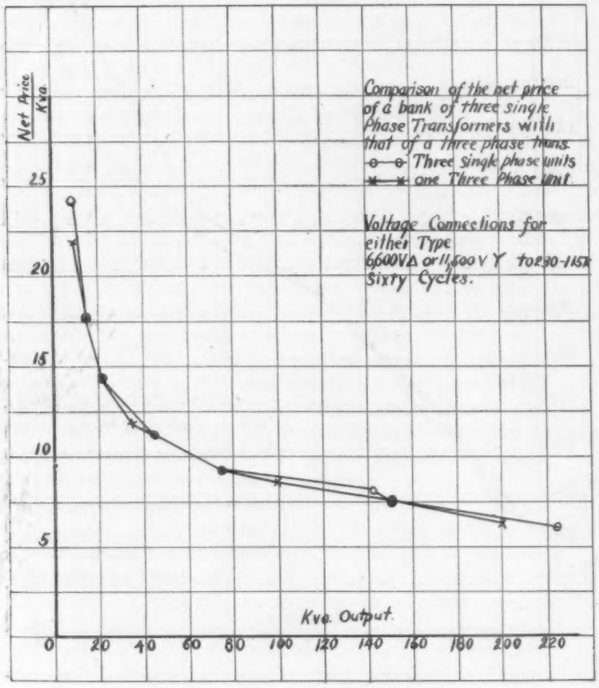

Net price Kva
Comparison of the net price of a bank of three single phase Transformers with that of a three phase trans.
Three single phase units
one Three Phase unit
Voltage Connections for either Type
6600V Δ or 11,500 V Y to 230-115
Sixty Cycles.
Kva. Output.
0 20 40 60 80 100 120 140 160 180 200 220
5 10 15 20 25

Fig. 4.—Comparison of net price, 6,600 or 11,500-volt type

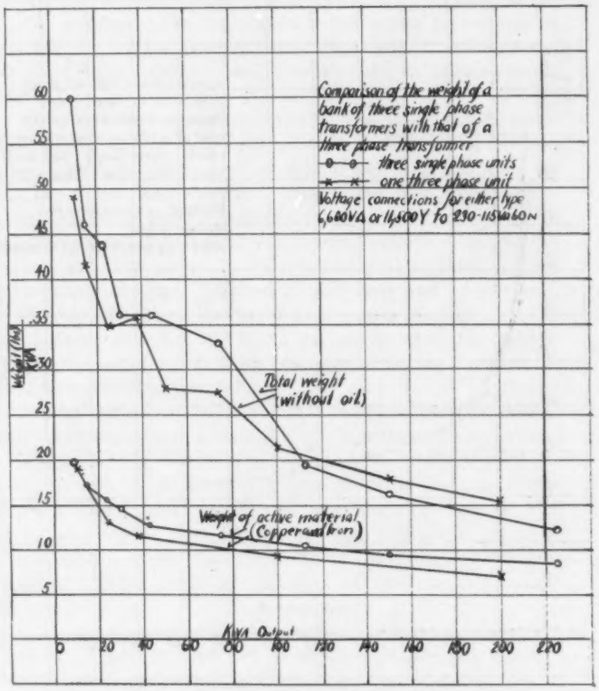

Comparison of the weight of a bank of three single phase transformers with that of a three phase transformer
three single phase units
one three phase unit
Voltage connections for either type
6,600V Δ or 11,500 Y to 230-115 60~
Total weight (without oil)
Weight of active material (Copper and Iron)
KVA Output
0 20 40 60 80 100 120 140 160 180 200 220
5 10 15 20 25 30 35 40 45 50 55 60

Fig. 6.—Comparison of weight, 6,600 or 11,500-volt type

voltage in the San Joaquin district is 220 volts, is largely the determining factor in favor of single-phase transformers, inasmuch as the size of one of the transformers in the bank can easily be adjusted to the size of the single-phase load. It was pointed out, however, that this unbalanced single-phase load is partially carried by all of the transformers in the bank, the proportion being approximately two-thirds of the single-phase load on the transformer in that phase, the remaining one-third being divided between the other transformers. This matter of single-phase load from 3-phase transformers is being met, however, by manufacturers of the 3-phase transformers by bringing out a 115-volt tap for small lighting loads or by increasing the copper on one leg of the 3-phase winding approximately 20 per cent, whereby a combination lighting, heating and power load may be obtained from the 3-phase transformer, this being accomplished with very slight additional expense in the manufacture of the transformer. It is felt by advocates of the 3-phase transformer that this provision meets all of the advantages claimed for single-phase transformers and that the greater compactness and simplicity of installation of the 3-phase units more than offsets the slightly greater flexibility of the banks of single-phase transformers.

Representatives of manufacturers submitted to the committee very interesting and valuable data, covering the rela-

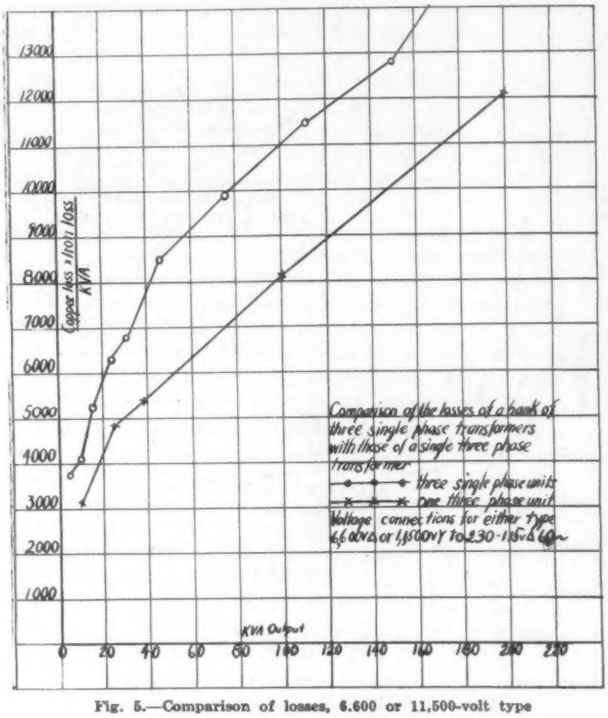

Copper loss + Iron loss KVA
Comparison of the losses of a bank of three single phase transformers with those of a single three phase transformer
three single phase units
one three phase unit
Voltage connections for either type
6,600V Δ or 11,500V Y to 230-115 60~
KVA Output
0 20 40 60 80 100 120 140 160 180 200 220
1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000 13000

Fig. 5.—Comparison of losses, 6,600 or 11,500-volt type

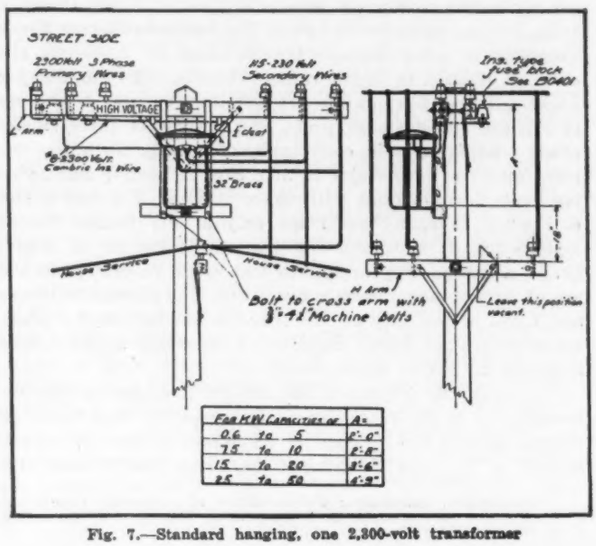


Fig. 7.—Standard hanging, one 2,300-volt transformer

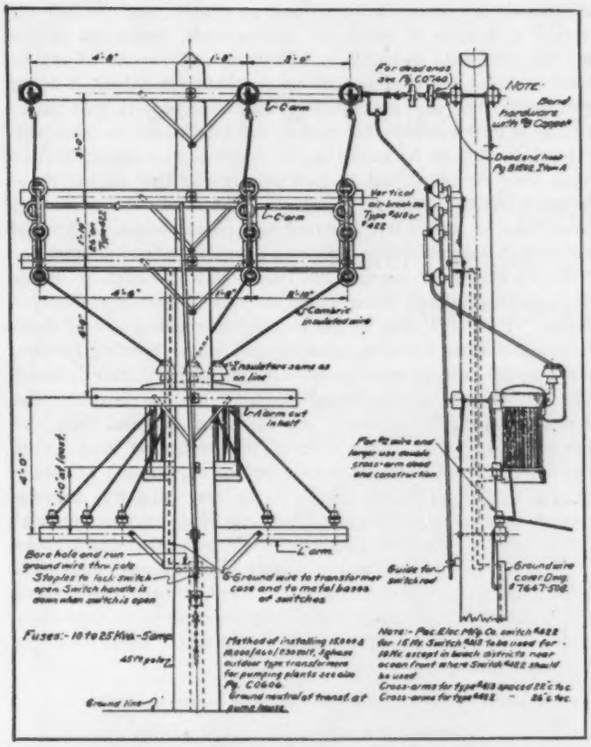

L-Arm
L-Arm
Vertical air-break sw.
Cambric insulated wire
Insulators same as on line
L-Arm cut in half
For #2 wire and larger use double cross-arm steel end construction
Bore hole and run ground wire thru pole
Steples to lock switch open. Switch handle is down when switch is open
Ground wire to transformer case and to metal bases of switches
L arm
Guide for switch rod
Ground wire cover Dwg. #7647-596
Fuses:- 10 to 25 Kva-Samp
45 ft pole
Ground line
Method of installing 15 kva & 25 kva 2200/440/230 volt, 3 phase outdoor type transformers for pumping plants see also Pg. C0604
Ground neutral of transf. at pump house.
Note:- Pac. Elec. Mfg. Co. switch #422 for 15 Kv. Switch #423 to be used for 10 Kv. except in beach districts near ocean front where Switch #422 should be used
Cross-arms for type #423 spaced 22" c. to c.
Cross-arms for type #422 " 24" c. to c.

Fig. 8.—Standard hanging, one 15 and 10-kv. transformer

tive quantities of material used and costs of production of 3-phase and single-phase transformers for equivalent service. It appears that in the lower voltage—that is, 2,300 to 6,600 volts—there is very slight, if any, real difference in either cost or efficiency between the two types. Transformers of 11,000 volts and above show some advantage of the 3-phase transformer, which advantage increases with the higher voltages, amounting to from 5 to 15 per cent. The total weight of material averages approximately 10 to 20 per cent greater

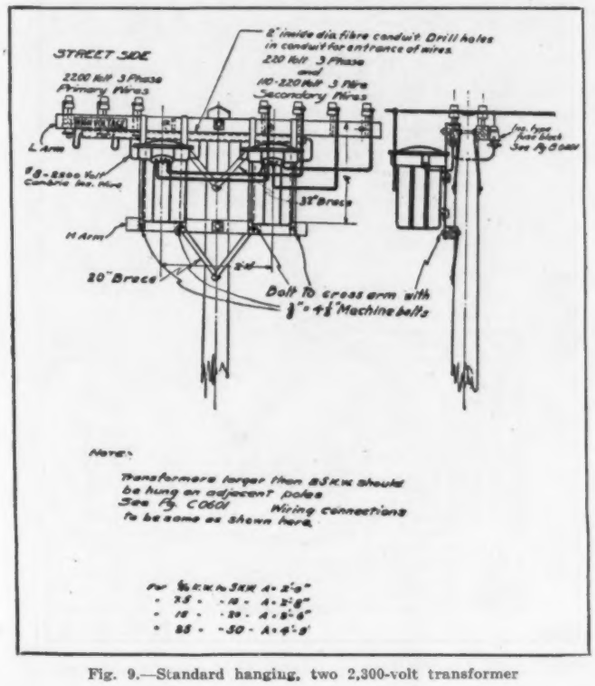

STREET SIDE
2200 Volt 3 Phase Primary Wires
2" inside dia. fibre conduit. Drill holes in conduit for entrance of wires.
220 Volt 3 Phase and 110-220 Volt 3 Wire Secondary Wires
L Arm
#8-2200 Volt Cambric Ins. Wire
32" Brace
H Arm
20" Brace
Bolt To cross arm with 5/8" x 4 1/2" Machine bolts
Transformers larger than 25 K.V.A. should be hung on adjacent poles See Pg. C0601 Wiring connections to be same as shown here.

Fig. 9.—Standard hanging, two 2,300-volt transformer

for single-phase units than for 3-phase, even in the 2,300-volt class. It was pointed out that the proportion of sales for both the General Electric and Westinghouse companies for the past year has been only 3 per cent of 3-phase as against 97 single-phase, and for this reason the cost of the 3-phase is higher in proportion to the material used and must necessarily continue higher unless the proportion of output is very greatly increased. It was pointed out that this pro-

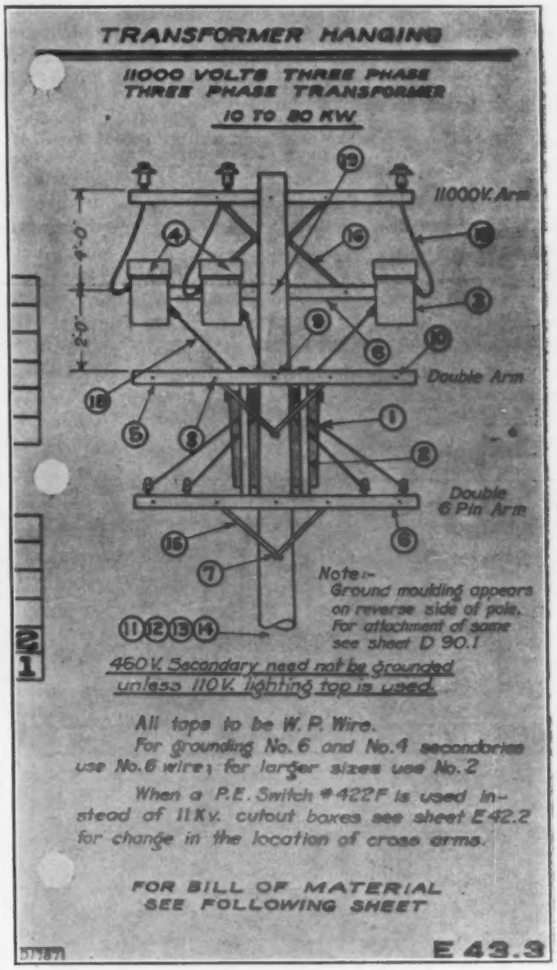

TRANSFORMER HANGING
11000 VOLTS THREE PHASE
THREE PHASE TRANSFORMER
10 TO 50 KW
11000 V. Arm
Double Arm
Double 6 Pin Arm
Note:-
Ground moulding appears on reverse side of pole. For attachment of same see sheet D 90.1
460 V. Secondary need not be grounded unless 110 V. lighting tap is used.
All taps to be W. P. Wire.
For grounding No. 6 and No. 4 secondaries use No. 6 wire; for larger sizes use No. 2
When a P.E. Switch #422F is used instead of 11 Kv. cutout boxes see sheet E 42.2 for change in the location of cross arms.
FOR BILL OF MATERIAL SEE FOLLOWING SHEET
E 43.3

Fig. 10.—Standard hanging, 11,000-volt, 3-phase transformer

portion of sales resulted in development of the single-phase transformers being much more specialized than the 3-phase.

Methods of Mounting 3-phase and Single-phase Distribution Transformers

A large number of working drawings showing the practice of the several operating companies with respect to transformer mountings on overhead distribution pole lines were submitted and copies of some are attached hereto.

With respect to transformer protection, it appears that none of the California companies provide lightning protection for each transformer or bank of transformers, and that in some districts it has not been found necessary or advisable to provide any lightning protection except at generating or substations and the more important transformer installations. Discussion on this subject, however, seemed to indicate that more attention should be given to lightning protection than in the past, and that except in most favored localities suffi-

cient lightning arresters should be distributed over the system to drain off excessive potentials, due to lightning induction.

Practice Relative to Transformer Repairs

It appears that the practice varies widely among the various companies with respect to repairs of small distribution transformers. Generally speaking, it is not considered economical to repair damaged coils of transformers less than 3-kva. capacity, and some companies place the limit higher. Most companies purchase completely wound and impregnated coils or have them re-wound by commercial repair houses. It is apparently the consensus of opinion that it was not economical to make repairs in excess of about 60 per cent of the first cost of the transformer.

Means and Appliances for Determining Actual Load of Distribution Transformers

The most generally used method was shown to be by means of routine tests with either indicating or recording instruments determining the actual load on transformers under maximum conditions or where recording instruments are used over a sufficient period to include maximum demand. In the absence of such tests, records of approximate connected load and application of established demand factor appear to be the most generally used system of transformer load control and determination. There was evident, however, an insistent demand for some simple and inexpensive device to be applied to a large number of all transformers, which would only indicate when a dangerous overload existed or had existed, but would also give at least an approximate indication of the actual maximum demand, in order that conditions of underload could be detected as well as overload conditions, it being pointed out by many operating engineers that it was materially as important to know that the transformers were well loaded as it was to guard against overload. Many devices have been produced, but it does not appear that as yet there is anything on the market which quite meets the necessary conditions of simplicity, low cost and effectiveness. A limited amount of data has been collected relative to load factors for different classes of service, but this is not of sufficient extent or in suitable shape from which to make any comprehensive report. However, due to the rapidly increasing use of combination electric lighting, cooking and water heating service, the demand factors on such service are of particular interest and further data should be collected. From the data at hand it appears that this class of service has a demand factor of approximately 33 1/3 per cent of the connected load. This has been arrived at from consideration of graphic ammeter records on transformers of 25 to 50-kva. capacity, serving groups of mixed lighting and heating loads in the Imperial Valley towns. Each of these groups represented from 10 to 15 electric range and water heater installations, combined with from 50 to 100 lighting consumers in each group, and are, therefore, considered a fair representative of this class of service where the electric range and water heater load is fairly well dveloped.

TRANSFORMER HANGING

CONTINUED

BILL OF MATERIAL

ITEM	DESCRIPTION	QUANTITY
1	K.W. 3-Phase Transformer	1
2	Standard Hanger	1 pr.
3	11Kv. Cutout Boxes (Style 1)	1
4	11Kv. " " (" 2)	2
5	Standard Transformer Arms	2
6	6 Pin Cross Arm, Yellow	1
7	½ x 3½" Galv. Lag Screw	5
8	⅝" x 4½" " Machine Bolt	10
9	⅝" x 18" " Thru Bolt	2
10	⅝" x 18" " Space Bolt	4
11	*6 W.P. Copper Wire	30 ft.
12	Ground Wire Moulding	30 ft.
13	Moulding Straps with Screws	7
14	Ground Pipe	1
15	28" Galv. Cross Arm Brace	8
16	36" " " " "	2
17	⅝" x 6" Galv. Machine Bolt	6
18	#6 11Kv. R.C. Wire	25 ft.
19	⅝" x 14" Mach. Bolt	1
20	Jackson Clamps	3
21	6 Pin Cross Arm, Green	2

* Omit when not grounded

E43.31

Fig. 11.—Bill of material for Fig. 10

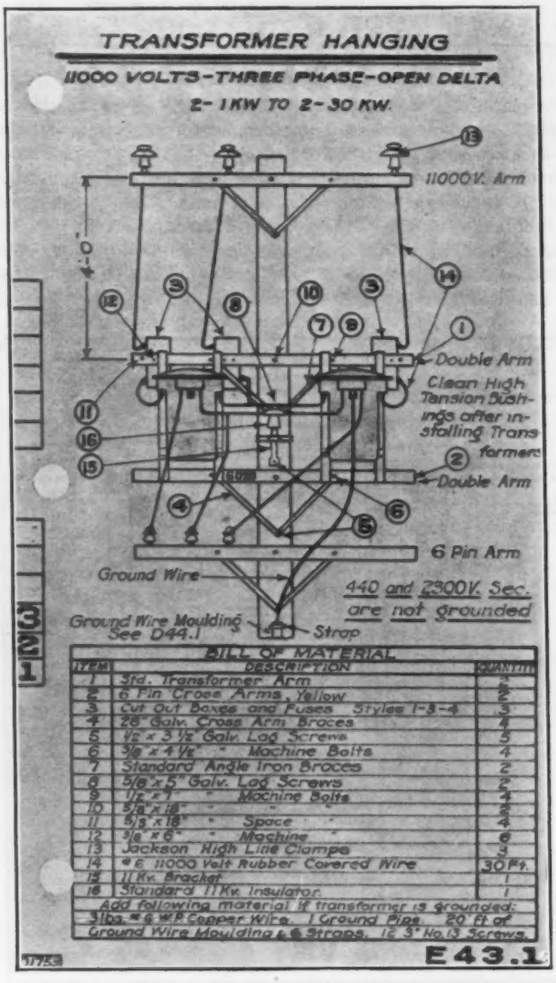

TRANSFORMER HANGING
11000 VOLTS-THREE PHASE-OPEN DELTA
2-1KW TO 2-30 KW.
11000V. Arm
Double Arm
Clean High Tension Bushings after installing Transformers
Double Arm
6 Pin Arm
Ground Wire
440 and 2300V. Sec. are not grounded
Ground Wire Moulding See D44.1
Strap
BILL OF MATERIAL
ITEM
DESCRIPTION
QUANTITY
1 Std. Transformer Arm 1
2 6 Pin Cross Arms, Yellow 2
3 Cut Out Boxes and Fuses Styles 1-3-4 3
4 28" Galv. Cross Arm Braces 4
5 ½" x 3½" Galv. Lag Screws 5
6 ⅝" x 4½" " Machine Bolts 4
7 Standard Angle Iron Braces 2
8 5/8" x 5" Galv. Lag Screws 2
9 ½" x 9" " Machine Bolts 4
10 ⅝" x 18" " " " 2
11 ⅝" x 18" " Space " 4
12 ⅝" x 6" " Machine " 6
13 Jackson High Line Clamps 3
14 #6 11000 Volt Rubber Covered Wire 30 Ft.
15 11 Kv. Bracket 1
16 Standard 11 Kv. Insulator 1
Add following material if transformer is grounded:
3 lbs. #6 W.P. Copper Wire, 1 Ground Pipe, 20 ft. of Ground Wire Moulding & 6 Straps, 12 ⅜" No. 13 Screws.
E43.1

Fig. 12.—Standard hanging, two 11,000-volt, 3-phase transformers.

PACIFIC COAST ELECTRICAL ASSOCIATION

SEVENTH ANNUAL CONVENTION

Hotel Fairmont, San Francisco, Calif.

June 19 to 23, Inclusive

HOTEL FAIRMONT

Program

Tuesday, June 19, 1923

9 a.m. to 12 m.—Registration

12 m. to 1:30 p.m.—Electric Vehicle luncheon with San Francisco Electrical Development League and Electric Transportation Club.

2 to 5 p.m.—Commercial and Technical Committee Meetings.

8:30 p.m. to 12 m.—Showing of Publicity Committee's film on Power Development and Utilization to be followed by dancing.

Wednesday, June 20, 1923

9:30 a.m. to 12 m.—General Business Meeting. Address of welcome by Hon. James Rolph, Jr., Mayor of San Francisco. President's Address, James B. Black.

2 p.m. to 5 p.m.—Commercial and Technical Committee Meetings.

8:30 p.m. to 12 m.—Dancing.

Thursday, June 21, 1923

9:30 a.m. to 12 m.—Commercial and Technical Committee Meetings.

12 m. to 5 p.m.—Luncheon at San Francisco Golf and Country Club and Golf Tournament.

8:30 p.m.—Grand Ball with special features.

Friday, June 22, 1923

10 a.m. to 12 m.—General Business Meeting.

2 p.m. to 5 p.m.—Western Development Conference. This conference will be of unusual importance and will be participated in by some of the most prominent men in the West.

6:30 p.m.—Banquet.

10 p.m.—Polyphase Pageant of Progress with 200 participants in costume.

Saturday, June 23, 1923

9:30 a.m.—Trip to Mt. Tamalpais over the crookedest railroad in the world, including luncheon at Tavern and return trip through Muir Woods.

Besides this general program there will be a special program for the ladies, which follows:

Wednesday, 9:30 a.m.—Automobile trip around San Francisco.

3 p.m.—Shopping tour of principal department stores.

Thursday, 9:30 a.m.—Automobile trip of East Bay District, including luncheon at Claremont Country Club.

Friday, 9:30 a.m.—Putting contest in lobby of Fairmont Hotel.

2:30 p.m.—Special trip through Chinatown.

ELECTRICAL CONSTRUCTION

By E. Earl Browne

AS Mr. Browne points out in the accompanying article "one lumen applied in the proper direction is of more value than ten applied in a haphazard manner." A little thought given to the placing of sockets or outlets at convenient places, especially in the location of lighting outlets, will in many cases greatly improve the electrical installation.

ONE of the conclusions drawn by the Residence Lighting Division, Lighting Sales Bureau of the National Electric Light Association from a survey of residence lighting was that the "average wired home today might be said to be less than 'half lighted'." It is well known that a large percentage of homes are inadequately and improperly illuminated. "Inadequate," because the public has not been convinced of the importance of modern lighting, and is largely unconcious of its many possibilities; "improper," because too little thought is given by the electrical contractor and architect in the location of lighting outlets so that the maximum benefits are not derived. The proper location of ceiling and bracket outlets is of the utmost importance, as one lumen applied in the proper direction is of more value than ten applied in a haphazard manner.

Fig. 1.

The average kitchen is an example of "how it should not be done." In the majority of instances the only means of illumination is a single ceiling light in the center of the room so that the housewife stands between the reflected light and the work which she is performing. Examples of bad practice (Fig. 2) and correct illumination (Fig. 1) are shown in the accompanying sketches. The kitchen should be provided with a bracket light over the center of the sink, controlled by a push switch. A central ceiling light, preferably of the enclosing "mushroom" shaped globe of white glass, is necesary and should be equipped with a lamp of adequate wattage.

A large kitchen should have an additional light over the stove or table. The range, especially where a cabinet warming oven extends the full length of the range, is most difficult to light from any position. This difficulty can be overcome by placing one or more outlets under the hood. In case outlets are installed under the hood, surface type pipe fittings with keyless porcelain receptacles should be used, and slow burning (type S. B.) wire. The conduit can be run down the rear of the range and through the floor and over to the control switch on the wall. Fig. 3 shows a recommendation which is not, in my opinion, good construction, as in order to be low enough to illuminate all of the utensils and their contents, the lamp would be in the housewife's way when using the range.

Fig. 2.

A built-in or flush type ironing board is in many cases installed in the kitchen. This also is seldom properly lighted. A woman when ironing stands on the right hand side of the board and the light source should therefore be directed so as to eliminate any chance of her forming a shadow on the work.

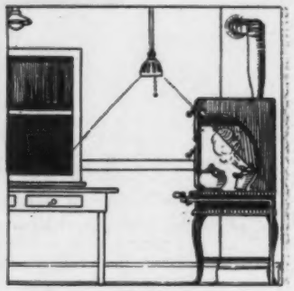


Fig. 3.

The laundry wash trays should be illuminated by a ceiling outlet two feet from the wall and in line with the extreme right or left hand end of the trays, depending on whether the washing machine is to operate in or out of the left or right hand tub. The sketch (Fig. 9) shows the correct position for a left-hand machine. This also provides illumination in case it is desired to use a portable ironing board in the laundry as is indicated in Fig. 5.

All closets, and particularly clothes closets, should have the outlet over the door. In many cases inspection departments insist on this location due to the fire hazard if it is placed on a side wall or near a shelf where combustible material might come in contact with it. A flush door switch of the open circuit type will insure that the light is not left burn-

ing when the door is closed. With this type of installation, in order to overcome the disadvantage of requiring that the closet door be kept tightly closed, a key or pull socket should be provided, in case it is desired to air the closet during the day. In a pantry closet where the door is apt to be kept ajar a pull socket, as in the accompanying sketch, (Fig. 4) or a push switch should be provided.

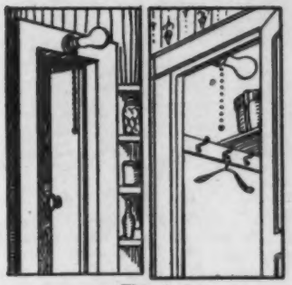


Fig. 4.

The average home does not contain a sufficient number of wall brackets. This is particularly true of the bath room. The bath room mirror is rarely ever properly illuminated, particularly for shaving. The mirror should be lighted by two brackets (double the number usually employed), one on each side of the mirror and about four inches below the center. A correct installation is shown in Fig. 8. The light on either side of the mirror will direct the light upon the face, where it is most needed.

In the bedroom specialized lighting rather than general illumination is the essential requirement for comfort. Mirrors are apt to be moved from time to time to suit the aesthetic tastes of the occupant. It would be by the merest luck if bracket outlets were placed to fit mirrors of varying size and shape. It is therefore preferable to wire the furniture. By having convenience outlets on the four sides of the room it is always possible to arrange the dressers or dressing tables as desired, still having the proper light on either side of the mirror and level with the face. The sketch (Fig. 6) shows the inadequacy of having only a central fixture suspended from the ceiling, contrasted with proper brackets. Convenience outlets conveniently located in the bedroom insure comfort in the use of warming pad, reading lamp, curling iron, vibrator and other devices.

Fig. 5.

The dining room should be the easiest to illuminate and more a problem of the fixture designer. Although wall brackets can be effectively used over buffet or serving table, a central ceiling outlet is all that is usually required. In case a pendant bowl type fixture is used, the dome should be placed high enough so that the vision across the table is not obstructed, yet low enough to protect the eyes from the rays of the light within. In general, if a distance of 22 in. between the top of the table and the bottom of the fixture is maintained the results desired will be obtained. This is shown in an accompanying diagram (Fig. 7). In the dining room and breakfast room a floor plug should always be installed in order that percolators, toasters, chafing dishes, or portable lamps may be easily connected by use of a multiple receptacle.

Fig. 9.

An Inquiry About Service Switches

Referring to Fig. No. 2, page 332, of the May 1 issue, a reader has asked why the meter was shown at the top of the service switch instead of at the bottom, since the method shown required the wire being run from the bottom lugs of the switch up to the meter and back to the busbar trough. This, in his opinion, seemed a rather difficult job.

In reply, I must agree that this recrossing of wires seems quite unnecessary, but as the wire used in this case is but No. 2 B. & S. gage the extra work involved is not serious, and at the present time this is the only answer to the problem if a symmetrical job is to be done, for the following reasons:

1st—Entrance switches for use with meter protective trims are made "open-top-end" only.
2nd—Present stocks of power company's meters are bottom connected.

While it is true that the bus cabinet and circuit switches could be placed on a line above the handle of the entrance switch, thereby eliminating the wires from load side of meter running beside switch, it is, however, a much neater job if both entrance and circuit switches line up as nearly as possible. This could be done by placing the circuit switches below the busbar trough, but, since circuits generally run to the ceiling and not to the floor, this would necessitate the use of "L" type of exposed conduit fittings, and is not to be recommended.

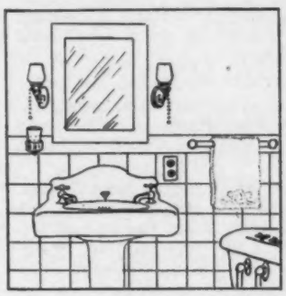


Fig. 8.

Fig. 6

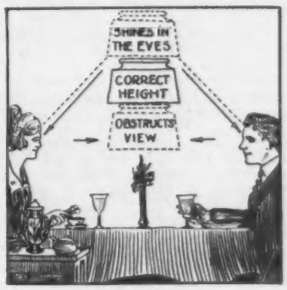


Fig. 7.

JOBBER, DEALER AND SALES AGENT

Develop Demand for Better Church Illumination

Electrical Service League of British Columbia Offers to Aid Churchmen in Improving Lighting Conditions

By securing the interest of the ministers and governing boards of the churches of Vancouver in proper illumination of their churches the Electric Service League of British Columbia is gradually getting the attention of the congregations turned toward a real interest in proper electrical installations.

The interest of the ministers and governing boards was obtained through the medium of direct mail advertising. Two letters were mailed, at an interval of one month, to allow for the meeting of the governing board in each church.

Letter No. 1

Dear Sir:

A poorly designed lighting system for the interior of a church affects not only the minister but his congregation.

He looks into the blazing lights instead of into the faces of his parishioners. They, in turn, suffer from eye fatigue, drowsiness and headaches caused by the same improperly concealed or shaded lamps. Because of the irritation they fail to sustain an interest in the service.

The congregation of any church is made up of three types—the person who attends regularly, the casual churchgoer and the one who attends because some one insists that he go to church just this once.

The first type will always attend, the second is apathetic and the third attends under compulsion. In order that a church may serve its little community to the fullest extent it must attract and hold the last two types or classes of people —to do this outside irritations must be removed.

A well lighted church is an attractive church and houses an attentive congregation.

Our business is illumination, and we will be very glad to advise you as to proper illumination. I trust we can be of service to you in a purely advisory capacity, for which service we make no charge.

Very truly yours,

SECRETARY-MANAGER.

Letter No. 2

Dear Sir:

Since writing your church on the subject of illumination recently I have made this very interesting discovery—IF OUR HOMES WERE AS POORLY LIGHTED AS MANY OF OUR CHURCHES our eyes would soon be seriously affected.

Congregations recognize that discomfort and irritation result from poor lighting and various arrangements of controlling the lights are tried to overcome the obstacle of improper lighting.

This discomfort is an obstacle over which the minister must carry his message to the congregation. To get the maximum effect from any speaker's effort the audience should be entirely at ease and able to look at the speaker without the least possibility of irritation from eyestrain. Such irritation to the members of a congregation can be removed by the use of proper luminaires.

Our business is illumination and we are offering to render you a free service in advising as to the proper illumination of your building. A number of churches have already availed themselves of this opportunity. Are you going to miss the chance of finding out what is really wrong with the lighting installation in your church?

For this service write to the address on this letterhead or telephone Seymour 5000 and ask for the Electrical Service League.

Very truly yours,

SECRETARY-MANAGER.

Church lighting is notoriously bad and is a constant annoyance to the congregation, so that the offer of advice as to a proper lighting installation has met with a good response. Already a number of churches are preparing to change their lighting installations as the result of this campaign.

Through the cooperation of the central station, churches desiring to make such a change have been furnished with a complete layout by the illumination engineer of the central station. Architects, too, have recognized the value of the service offered and have obtained the advice of the fieldmen for the league on the electrical installations in several new churches under construction.

The campaign is still in progress, but results are already gratifying.

SUCCESS NOT A CHANCE—LUCKY STIFFS BARRED

By JOE OSIER

Several thousand years ago as the summer sun was clipping the hilltops and the birds were tunefully warbling—

O, Happy Day—

Hairfaced Harry, the Sage of Stoneville, hastily swallowed the last bite of marrow in his cave, wiped his greasy hands on his flanks, picked up a chisel and hammer and began—

Pecking away on an editorial headed "Success."

Laboriously he spelled out these lines: "Some people think of success as chiefly a matter of chance, of good or bad luck, when in reality it is more a matter of choice than of chance."

This task completed, he buzzed for his stenographer, telling her to "strike off 10,000 copies and dispatch them on the afternoon stone boat—then—

Hairfaced Harry called it a day, picked up his golf clubs and dangled out in the country for a few rounds of prairie pool.

And, today, conditions and men are practically the same.

For instance: William William McWilliam, noted author and "wise cracker," buzzes for his stenographer and says: "Liztakeletter."

And he begins: "To the employees of The Wonder Working Woofus Works:

"Some people think of success as chiefly a matter of chance, of good luck or bad luck, when in reality it is more a matter of choice than of chance. * * *"

And in this day of Our Lord, 1923, sitting in my office with the sounds of the city all about me, I am glad that I am forced to agree—

"Ain't it the truth."

And it is the truth—and when the men engaged in all lines of endeavor hug this truism to their palpitating bosoms—

There will be fewer overdue notes and many healthier bank balances.

I realize, it is extremely hard for the second low boys, who have been aced out of a fat contract to sing:

"We'll get pie in the sky"—still—

Seeing that Success is a flirtatious wench and hard to woo, the reward cannot be expected to come easily—however:

Success can be wooed and won and wedded, as has been proved by men who started in life with less than nothing and finished with everything—

Including a pass inside the Pearly Gates.

Still, seeing that most of us are interested mainly in assuring ourselves a competence and a "place in the sun," I shall refrain from further remarks about things I know nothing of—

Including the Pearly Gates—and—

Continue with the subject of Success because—

I know, surely, Success will dog the footsteps of any man who—

Does the right thing, in the right way at the right time—

Providing he does it often enough.

Success is not a matter of chance else there would be more successful men—because—

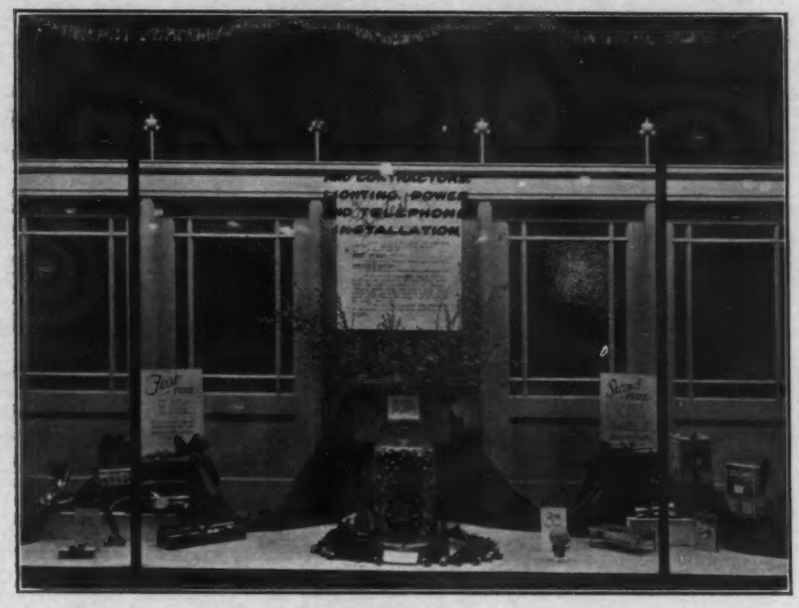
Every day men are taking chances.

And some wake up in the hospital—some at the Poor Farm and others are standing in line in front of soup kitchens.

In my opinion, which is worth whatever you think it is, the men who think Chance and Success are twins, had better get out of the race and let somebody run—

That can run.

If I'm wrong, show me where.



This window display of J. J. Agutter & Company, Seattle, Wash., gave passers-by an opportunity to guess how many plugs were in the vacuum jar. Prizes given to winners may be seen on the sides.

Pull the Casual Window-Shopper into the Store

Seattle Electrical Contractor-Dealer Introduces Large Number of Prospects to Store by Using Guessing Contest

To the average citizen the contest in which he can use his wits to secure a prize at no cost always has a definite appeal. Guessing contests that permit people to state the number of articles that are assembled in a certain space have always proved popular means of attracting attention. The electrical dealer has been rather handicapped in this field because most of his stock is of such a nature that he cannot group it for the purpose of arranging a contest. The size and delicacy of electrical appliances have been obstacles which prohibit the dealer from pouring them into a pile for guessing purposes.

J. J. Agutter & Company of Seattle, Wash., overcame this difficulty by filling a vacuum jar with Clearsite plug fuses. Plug fuses are small enough and are strong enough to permit the dealer to put them in a jar and mix them up sufficiently to make the guessing fairly difficult.

The Seattle firm did this and placed the jar of fuses in the display window, using appropriate hand lettered cards to announce the contest. These cards stated the rules of the contest and told the people who stopped to look at the display how guesses might be made.

The rules of the contest were as follows:

Guesses are free and you do not have to make a purchase.

Contest is open to anyone not connected with this firm and will be run for two weeks.

The winners will be—

First Prize.—The first correct or nearest correct guess deposited.

Second Prize.—The second correct or nearest correct guess deposited.

If two or more deposit the correct answer prizes will be awarded in the order of date deposited. All tickets are numbered and dated. Get your ballots inside and deposit in box. The winning names and numbers, together with the correct count, will be shown in this window after the close of the contest, March 12.

Prizes will be awarded upon presentation of duplicate receipt and proper identification of holders.

As may be seen from these rules, the company protected itself from the possibility of having to give two prizes in case of duplicate answers. By dating the guesses, the company protected itself and made the contest more systematic. Early entrants were given a preference in this way and it tended to make passers-by make their guesses immediately instead of waiting to do so.

The prizes given were of course electrical appliances. The winner of the first prize was given a choice of a Westinghouse toaster, Universal electric iron, Universal or Westinghouse curling iron. A package of six 40 or 50-watt Westinghouse Mazda lamps, a Diamond focusing or Everready flash lamp, a Holdheet grill or curling iron, were the articles from which the winner of the second prize could take his choice. Third and four prize winners were given no choice.

The results of the contest were very gratifying to the management of the Seattle store. A number of prospective customers were introduced to the store through the contest and trade was stimulated considerably. The receipt which was given to each person who made a guess contained a complete list of the appliances carried by J. J. Agutter & Company and served as a good piece of direct advertising. In conducting a campaign of this nature it would also be possible to secure a good mailing list by taking the names of all contestants.

The Seattle dealer was aided in the contest by W. E. Jones, local manager of the Economy Fuse Company, the distributor for the line of Clearsite fuses.

Los Angeles Attorney Prepares Mechanics' Lien Form

The mechanics' lien law, being a summary and preferential remedy, has long been strictly construed by the courts. There are often so many angles involved in the foreclosure of a mechanics' lien, where other liens, mortgages and trust deeds are involved, that this branch of the law has become more or less a specialization, and many attorneys specialize solely in this practice. Mechanics' lien laws have been frequently changed and amended, and forms that were at one time sufficient, may now be defective. For the purpose of providing a simple method of enabling the electrical contractor to file a lien to secure labor or material, Attorney Earl E. Moss, 624 Stock Exchange Building, Los Angeles, has prepared a form for liens, with instructions for filling it in, for free distribution to contractors in Los Angeles and vicinity. Mr. Moss has written the Journal of Electricity and Western Industry as follows:

"It is the practice of many electrical contractors to use the stock forms that may be purchased in any stationery store for preparing and filing liens. Where the amount involved is small, the expense of employing an attorney to prepare the lien is not justified, and the filing of such liens, even though sometimes defective, ofttimes force payment or compromise of the claim.

"These forms are occasionally used, however, for filing liens where a considerable amount is involved, which are contested and require a court action to foreclose, and in such cases are subjected to a careful scrutiny for defects. Many of these forms do not comply with the amendments and changes in the law. I have printed forms that I use for filing liens, together with instructions for preparing lien, which any electrical contractor may secure without charge or obligation of any sort by calling at my office, or they will be mailed upon a telephonic request.

"Another matter that is often overlooked by laymen in filing these mechanics' liens is that the lien continues in force for ninety days only, unless action be instituted for foreclosure, or unless by agreement of both parties a credit is given, which extends the time for filing the action ninety days after the expiration of such credit, but even such agreements to extend credit cannot continue the lien in force longer than one year, unless an action be filed."

Mr. Moss specializes in law practice in the electrical industry. He prepared the form of lease contract for the sale of washing machines, vacuum cleaners, and other appliances, upon deferred payments, that was adopted by the Electrical Retail Dealers' Association of Los Angeles. He also prepared the form of wiring contract described and printed on pages 146 and 147 in the issue of Feb. 15, 1923, of the Journal of Electricity and Western Industry.

INDUSTRIAL NEWS

Organization Opposes $35,000,000 Los Angeles Bond Issue

Opposition to the $35,000,000 bond issue for the Public Service Commission of the City of Los Angeles, which will appear on the municipal ballot on June 5 as Proposition No. 6 has taken definite form in the formation of the Los Angeles Taxpayers' Association, by a group of prominent citizens. Approximately $10,000,000 of the money to be derived from the bond issue is to be spent for rehabilitations to the distribution system of the city and additions to the present hydroelectric system. The remaining $25,000,000 is to be used for the power development at Boulder Canyon on the Colorado River.

William C. Warmington, who has been active in civic-betterment movements, is chairman of the new organization, and among the leading citizens at the head of it are William May Garland, Harold L. Arnold, D. A. Hamburger, M. A. Hamburger, Fred L. Baker, O. P. Clark, Louis M. Cole, B. H. Dyas, Mrs. Cora Deal Lewis, Mrs. Charles F. Gray, W. W. Mines, Ralph Hamlin, Robert H. Moulton and J. B. Van Nuys.

In a formal statement issued by Chairman Warmington, the association makes the following points against issuance of the $35,000,000 in bonds:

"Voters are called upon to express themselves at the June 5 election on the question of issuing $35,000,000 more of power bonds, $25,000,000 of this Los Angeles money to be spent in the State of Arizona when the Boulder Canyon Dam is completed.

"There is no dam at Boulder Canyon as yet. The Federal government will build that project, not Los Angeles. Seven states must consent to its building and seven states will receive the benefits. They are Wyoming, Nevada, Colorado, Utah, New Mexico, Arizona and California.

"The Federal government will provide for the development and distribution of power, not Los Angeles or any other city. That point has been agreed upon by the states interested. Government engineers estimate that the cost of the dam, power plants and transmission lines will be $133,000,000.

"Interference by Los Angeles at this time can do nothing but impede the government. Six of the seven states which control the waters of the Colorado River have ratified this agreement, but Arizona has not approved the pact and its final favorable action is being prejudiced by the Los Angeles agitation."

Seattle Company Plans Erection of Connecting Line

The Puget Sound Power & Light Company has recently made application to the county commissioners of Thurston County, Washington, for a permit to erect a transmission line from Olympia to Tenino, Wash. This line would be the connecting link in the Stone & Webster system in western Washington. The line would give a continuous system extending from Bellingham on the north to the Columbia River on the south.

The company has had a high tension power line from Tacoma to Olympia and Tumwater for several years, bringing the current from the Snoqualmie power plant for use of the Olympia Light & Power Company during the hours of its peak load. The Stone & Webster interests also have acquired control of the North Coast Power Company, which operated its power plant in Kalama and served Chehalis, Centralia and Tenino. This gap between Olympia and Tenino is now to be closed.

This will provide a safeguard in case of accident to a power plant, since all the generating plants of the company will be linked up and emergency service could be maintained with one plant down. Also, in the hours of peak load, it permits drawing from whatever plant has surplus power available.

The company has acquired the light and power system at Aberdeen. Construction work is in progress to connect Olympia and the Aberdeen plant through Montesano over the Olympia Highway commonly known as the McCleary Road. The Olympia-Tenino link will also serve to tie in the Grays Harbor system with the Kalama plant.

Suit to Secure Return of Water Right Opened by Company

The Progress Company, of Murray, Utah, has filed suit in the Third District Court against Salt Lake City. The company asks that an order of the state engineer denying the company the use of 100 sec.-ft. of water from the Big Cottonwood stream and diverting it to Salt Lake City be annulled and revoked.

The history of the controversy between these two agencies, now parties to the suit, dated back to 1909, when the Progress Company applied to the state engineer for the diversion of 100 sec.-ft. of water from the Big Cottonwood stream. Notice of the application was published, the complaint states, and a protest filed by Salt Lake City against the granting of the application. The protest was denied and the application for the water was granted. A court decision in 1911 brought by the city was dismissed.

In November, 1921, the city entered another protest with the state engineer against the use of 100 sec.-ft. of water by the Progress Company, on the ground that the company had not instituted improvements on a power project promised when granted the water right. This protest was sustained by the state engineer and the recovery of this water is now sought by the company. The complaint enumerates a number of construction projects which are now under way.

Street Railway Gives Order for Converter Equipment

The Market Street Railway of San Francisco has ordered additional converter equipment for its substations with a total rated capacity of 5,000 kw. This will be made up of two machines; one of 3,000-kw. and one of 2,000-kw. capacity.

The larger machine will be installed in what is termed the Down Town Substation. This station was originally equipped with two 2,000-kw. converters and the added machine will therefore bring the rated capacity up to 7,000 kw.

The general growth of street railway traffic in the congested down town district of San Francisco calls for this material increase of capacity. The departures from previous practices, incorporated with the original equipment will be continued in the extensions. The chief departure was the use of means for voltage control by varying, under any load condition, the number of primary turns in the transformers. The equipment for this purpose has proven highly satisfactory.

The new 3,000-kw. machine will be built for directed ventilation and will therefore avoid the usual difficulty of cooling such machines in substations on closely built up property. This will be the first railway converter to be so equipped. The air passages through the machine will be so arranged as to take air into the armature from the room at both the collector and commutator ends, and to blow it out radially around the pole structure into air ducts by which it will be carried away. This will avoid any enclosure of the parts requiring inspection and attention.

The 2,000-kw. machine ordered at the same time will be installed in the Eighth Avenue substation of the railway company to take care of the increasing travel in what is known as the Richmond District. This will also be equipped with means for voltage control similar to that referred to above, but will not have directed ventilation.

The order for the 3,000-kw. machine has been given to the Westinghouse Electric & Manufacturing Company. The order for the other machine has been given to the General Electric Company. The extensions are being carried out under the direction of Ford, Bacon & Davis, Inc., consulting engineers.

The enforcement of electric wiring rules in Colorado Springs, Colo., is being pushed by Joe Caldwell, city electrician, according to recent reports. The fact is evidenced by the number of violators brought before the police court in that city in every case of which a conviction has been secured.

Lewis A. McArthur, addressing the visitors prior to the starting of the new plant. Miss Prudence Talbot, who threw the switches that started and synchronized the plant, may be seen on the extreme left of the speakers' platform.

Powerdale Plant Is Dedicated by Oregon Company

Daughter of President of Pacific Power & Light Company Throws Switch and Starts 9,000-hp. Hydroelectric Plant

With appropriate ceremonies the Pacific Power & Light Company dedicated its new Powerdale hydroelectric plant on the banks of Hood River on May 10. Nearly 1,000 persons watched Miss Prudence Talbot of Portland throw the switches that started the water wheel and generator and synchronized the electrical apparatus with the plants operating on the systems of the Northwestern Electric Company and the Portland Railway, Light & Power Company which operate in unison with The Dalles-Hood River system of the Pacific Power & Light Company.

This hydroelectric development is situated on the east bank of the Hood River about one-half mile south of the city of Hood River, and is visible from the Columbia River Highway bridge, and also from the new Mt. Hood Loop Highway. The plant is modern and up-to-date in every respect and has a capacity of approximately 9,000 hp. It was built by the Phoenix Utility Company, a construction concern affiliated with the Pacific Power & Light Company. Construction work was started June 1, 1922, and in less than a year the plant was ready for service. Had it not been for exceptionally bad weather conditions last winter the new plant would have been available on April 1. The plant is one of a number operated by the Pacific Power & Light Company, which has headquarters in the Gasco Building, Portland, and serves the Astoria-Seaside district, The Dalles-Hood River-White Salmon territory and the entire southeast part of Washington from Yakima to Pomeroy, with branch lines as far south as Pendleton.

The dedication exercises were in charge of Lewis A. McArthur, vice-president and general manager of the Pacific Power & Light Company, who acted as master of ceremonies. Preceding the exercises, the Phoenix Utility Company served a buffet luncheon at its camp site and more than 700 persons partook of the refreshments. The opening remarks were made by Guy W. Talbot, of Portland, president of the Pacific Power & Light Company. Mr. Talbot spoke briefly of the development and enumerated some of the difficulties that had been overcome, and praised those in charge of the construction work, including H. H. Schoolfield, chief engineer, and J. E. Shinn, superintendent of construction. Immediately following Mr. Talbot's remarks, Mr. McArthur introduced L. B. Gibson, superintendent of schools for Hood River County. Mr. Gibson was followed by Judge Fred W. Wilson, of The Dalles, Circuit Judge of the Seventh Judicial District and president of the Oregon Bar Association. Mr. McArthur then introduced various company officials, including John A. Laing, vice-president and general attorney, Geo. F. Nevins, secretary and treasurer, John V. Strange, assistant general manager, H. H. Schoolfield, chief engineer, J. E. Shinn, superintendent of construction, Berkeley H. Snow, district manager at Hood River, and J. B. Kilmore, district manager at The Dalles, who is also superintendent of power of The Dalles-Hood River system.

Guy W. Talbot, president of the Pacific Power & Light Company (right), and Lewis A. McArthur, vice-president and general manager of the company, two of the men prominent at the dedication ceremonies of the Powerdale Plant. Miss Mary Lawrence McArthur is being advised to keep out of the picture.

Miss Prudence Talbot, daughter of Guy W. Talbot, dedicated the plant by pulling a lever which opened the Johnson hydraulic valve and admitted water to the power wheel, and as she did so said, "I dedicate you to useful public service." As soon as the water wheel was up to speed Miss Talbot operated several electric switches which synchronized the generator with the generators on the power system of the Pacific Power & Light Company, the Northwestern Electric Company and the Portland Railway, Power & Light Company which are operated as a single system. The machine slipped into speed and immediately picked up a load of about 5,000 hp. This is the first time on record that a young lady of Miss Talbot's years has been known to synchronize a power plant of 9,000-hp. capacity.

Water to be used in the Powerdale plant is diverted from the Hood River about 3½ miles from its mouth by means of a diversion dam equipped with steel roller gates which are electrically operated. The plant operates under a 187-ft. head, the water being led 15,985 ft. through a pipe line. This line provides the turbine with 500 sec.-ft. of water.

Report Discourages Erection of Municipal Water Plant

The report prepared by a special committee of the Chamber of Commerce of Logan, Utah, recommends that the city abandon plans to erect a new power plant and instead suggests that the city continue to purchase power wholesale from the Utah Power & Light Company. The report states that by purchasing power from the power company, the city can save approximately $5,000 a year.

A consulting engineer employed by the city to investigate the advisability of erecting a new municipal power house, estimated that the cost of this development would be approximately $266,000. The development suggested would be erected to operate at full efficiency at flood stages of the river only.

At present the municipal power bureau of Logan is supplying about 40 per cent of the city with power and light. About one-half of the power retailed by the city is purchased from the Utah Power & Light Company at a very low rate. The contract for power secured from the central station company has several years to run and permits the city to take any amount that it may require.

California Wire Company Opens San Francisco Warehouse

The California Wire Company of Orange, Calif., has recently opened a new warehouse in San Francisco where the company intends to carry a large stock of wire. The new building which was erected especially for the wire company is located at 431 Bryant Street.

J. N. Addis has been named branch manager for the San Francisco territory and it was under his direction that the new establishment was opened. Charles L. Hill, sales manager of the wire company, was in San Francisco for the opening of the warehouse. According to Mr. Hill, the company intends to carry a stock of about 150,000 lb. of wire at the new location. This will be on hand to supply local customers of the company who are in need of immediate delivery.

The California Cotton Cordage Company, a subsidiary of the California Wire Company, is increasing the capacity of its plant so that more insulating material can be made for the wire company. The cotton mill, which is also located at Orange, has been operating only a short time, but has already proved that it will be a success and that it can supply the insulating cotton needed by the wire company. A new machine has been ordered which, according to Mr. Hill, will double the capacity of the mill. The wire company is now taking the entire output of the cotton mill.

Arrangements are being made to hold a convention of the Mountain Division, Association of Electragists, International, at the Albany Hotel, Denver, Colo., on July 16. James R. Strong, of New York, who is president of the association, will address the convention as will also John F. Greenawalt, publicity manager of the Mountain States Telephone & Telegraph Company, Lawrence W. Davis and Arthur P. Peterson, the field man for the mountain division of the association. Complete details for the convention have not been definitely arranged.

Warehouse of the California Wire Company on Bryant Street, in San Francisco.

Harris J. Ryan Officially Named President of A.I.E.E.

Prof. Harris J. Ryan, of Stanford University, was declared officially elected president of the American Institute of Electrical Engineers for the coming year by the committee of tellers of the Institute at the annual business meeting on May 18. The other officers elected are: vice-presidents, H. E. Bussey, Atlanta, Ga.; S. E. M. Henderson, Toronto, Canada; William F. James, Philadelphia, Pa.; J. E. Macdonald, Los Angeles, Calif.; Herbert S. Sands, Denver, Colo.; managers, H. P. Charlesworth, New York, N. Y.; William M. McConahey, Pittsburgh, Pa.; W. K. Vanderpoel, Newark, N. J.; and treasurer, George A. Hamilton, Elizabeth, N. J.

These men with the hold-over officers will constitute the board of directors for the administrative year starting Aug. 1. Twelve states and Canada will be represented on the new board of directors.

Executives Visit Extensions of Spokane Power Company

During the week of May 7, a general survey of properties and territory of the Washington Water Power Company around Spokane was made by the following officials: D. L. Huntington, president; M. W. Birkett, general manager, both of Spokane; W. A. White, Frank Lyman, W. J. K. Vanston, New York directors; and W. B. Binnian of Boston, a stockholder of the company. The party inspected the Kettle Falls power site, the holdings of the Okanogan Valley Power Company, acquired last year by the Washington Water Power Company. The extensions of power transmission lines from the Big Bend country to the Columbia River connecting with the Okanogan system, the lines built into the Lake Chelan district, the lines built last year into the Ephrata and Moses Lake country in Grant county, and the recent extension to Quincy were also visited.

The Washington Water Power Company of Spokane, Wash., has been enlarging its territory during the last year, and in the near future will probably make application to the Federal Power Commission for a permit to begin the development of Kettle Falls, a power site on the Columbia River about 100 miles north of Spokane.

An advertising campaign designed to tell the people of Seattle about the municipally owned utilities of the city will be launched by the city council some time in the near future, if the plans submitted to that body by Supt. George F. Russell of the public utilities department are adopted. An appropriation of $40,000 a year for advertising purposes has been taken under advisement by the city council utilities committee. The money is to be furnished by the light, water and street railway departments.

Ordway, Crowley, and Sugar City are three small Colorado towns which have been provided with electric cooking schools by the Westinghouse Electric & Manufacturing Company in conjunction with the Southern Colorado Power Company. M. E. Lanning of the Denver office has been in charge with the actual instruction being given by Mrs. Clara hunt, a domestic science expert.

Reduction Made in Lighting and Power Rates in Seattle

Electric lights in Seattle for both residence and commercial lighting have been reduced by the City of Seattle light department. Following the city's move, the Puget Sound Power & Light Company announced similar reductions. Under the new schedule, the rate for residence and church lighting is reduced from 6 cents for the first 40 kw-hr. to 5.5 cents; next 200 kw-hr. 2 cents; all over 240 kw-hr., 1 cent. The $1 service charge is discontinued, the minimum charge now being 75 cents per month.

Commercial lighting rates show a reduction from 5.5 cents to 5 cents per kilowatt-hour for the consumption up to 100 kw. and 1.5 cents per kilowatt-hour for all current in excess. Commercial rates are subject to the following discounts based upon the maximum demand: 1 to 20 hp., no discount; 21 to 100 hp., 12½ per cent; 101 to 250 hp., 25 per cent discount; 251 hp. and over, 40 per cent.

The water heating rate is a flat rate of $4 per kilowatt a month. Provision is also made for special rates for current for household cooking and heating over a three-year period. The Puget Sound Power & Light's reduction corresponded closely to the new city rates.

Pelton Water Wheel Company to Erect New Building

The Pelton Water Wheel Company has acquired the property on the southeast corner of Nineteenth and Alabama Streets, San Francisco, and will erect a two-story modern factory, 150 by 200 ft., to be utilized for an office, drafting room, pattern shop, pattern storage room and pump assembly department. The total investment will represent $500,000.

The main building, occupying the block bounded by Eighteenth, Nineteenth, Harrison and Alabama Streets, will be used for the machine shop and turbine erection departments. This will make room for the installation of a number of large capacity machine tools and other equipment and, indeed, virtually double the manufacturing facilities of the company, it is said.

Present activity in the hydroelectric field, and the increasing tendency among western power companies to take advantage of local services are given as the reasons for the proposed enlargement.

Electrical Men of Los Angeles Hold Special Meeting

A special meeting of the Electric Club of Los Angeles was held on the evening of May 24, at The Elite, a Los Angeles restaurant. The purpose of the meeting was to give the members of the club more time to get together and in this way become better acquainted with each other. The committee in charge selected the evening meeting time to permit members, who were unable to attend the Monday noon lunches, to come to the large meeting.

During the evening a number of short talks were given by men of the industry in the southern California city and after this a well planned entertainment was provided for the diners. Al Morphy acted as toastmaster at the meeting.

Submarine Power Cable Is Laid Across Willamette River

The Northwestern Electric Company of Portland, Ore., has recently laid a new submarine cable across the Willamette River at Sellwood Ferry. The new cable will permit the company to serve the Sellwood section of Portland. The cable which has just been installed is a 3-conductor, 250,000-circ.mil, 13,200-volt, varnished cambric lead covered armored cable, 1,200 ft. long.

Because the company was in need of early delivery on the cable, the manufacturer was forced to furnish it in two pieces. These were spliced before laying was started and the 1,200 ft. of cable was laid in seven minutes. In laying the cable it was necessary to figure 8 one reel on the deck of the barge. The first half of the cable was laid from the figure 8 and the second from the reel, without any delay. Two tugs were used to tow the barge.

Cable-laying barge being used by the Northwestern Electric Company to lay new submarine cable at Sellwood Ferry, Portland, Ore. The cable was in two pieces and was spliced before laying started. The figure 8 which half of the cable made up may be seen on the deck of the barge.

Public Ownership Candidate Is Elected Denver Mayor

Ben F. Stapleton, former postmaster of Denver and candidate of Governor William E. Sweet of Colorado, was elected mayor of Denver, May 15, in one of the most bitterly contested elections ever held in Colorado. Of interest to the electrical industry is the fact that Governor Sweet before the campaign openly announced that he would not back a candidate who did not favor municipal ownership of all public utilities.

Of the seven candidates in the race, all but two, Mayor Stapleton and D. C. Bailey, who was defeated for re-election, expressed themselves unequivocally on this point. Whereas the other candidates accepted the issue as a subject of widespread interest, the two leaders kept this plank in the background.

Whether or not the veiled treatment given this issue by Mr. Stapleton was done intentionally because of the open stand of Governor Sweet has not been determined, according to the political wiseacres of Denver.

Although three years off, decision as to possible municipal ownership will be made during the term of the recently elected mayor and this accounts for its being injected into the spring campaign. Bailey, who was defeated, openly opposed the idea of municipal ownership during his administration. Although receiving the largest number of first choice votes in the election, he was defeated by a margin in excess of 6,000 second and third choice votes.

Mayor Stapleton's platform on the subject of public utilities as advertised prior to the election provided, "The mayor should make known to the public the true facts as to the value and cost of operations of the tramway and gas and electric properties. Our home rule charter requires the submission of all questions of ownership and franchise to the people for final decision. The duty of the city administration is to intelligently carry into effect the mandates thus expressed."

Before several audiences the newly elected mayor explained his platform by declaring for "the protection of the city's interests in the operation of public utilities and purchase of such utilities as can be purchased at a price which will permit the people to operate them advantageously."

Considering the jam the Denver traction company has been in since the strike of 1920, it appears from the campaign instituted in the courts to reduce the fares,—although the company is in the hands of a receiver,—that further efforts will be exerted by the city against the other utilities, a situation of which those interests are fully cognizant.

Progress on the Skagit River hydroelectric project under development by the City of Seattle is very satisfactory, according to C. F. Uhden, chief engineer. The city has secured title to practically all of the right-of-way for the 125-mile transmission line, on which construction will begin about June 1. Plans for the north end substation in Seattle are completed, and contract will be awarded shortly.

Central Station Merchandising and Credits Discussed

The regular quarterly meeting of the Pacific Coast Electrical Jobbers' Association was held at Del Monte, Calif., May 10-12.

In addition to the usual closed sessions, at which matters of intimate interest to the jobbers were discussed, there were two open meetings. One was devoted to credits, and one to the function of the central station with reference to the sale of electrical appliances.

S. B. Anderson, secretary-treasurer of the Pacific States Electric Company, San Francisco, read the leading paper, in which he traced the development of the theory of credits, showing its relationship to capital turnover. He used for illustration an interesting analogy to motor truck transportation by which a definite factory output was distributed in a series of stages, showing by this that continuity in manufacturing conditions was dependent equally upon capital turnover and the meeting of credit obligations, all three synchronizing to achieve commercial success.

Mr. Anderson was followed by George A. Van Smith, Jr., vice-president of the Anglo-London-Paris National Bank of San Francisco. Mr. Van Smith delivered a carefully conceived paper on the function of the bank in relation to credits. He emphasized the fact that the relation of the bank to a borrower was not that of an investor in the business, and that the borrower could not expect to do business on borrowed capital. The bank could reasonably be expected to provide the business man sufficient ready money to permit him to discount his bills, and beyond that—nothing. He stated that, generally speaking, bank credit was one of the most abused and least understood elements in business.

Mr. Van Smith was followed by W. E. Shepard, general credit manager of the Western Electric Company, New York City. He spoke of the credit aims of credit men, pointing out the aims and purposes of credit, and the type of customer from which most losses occur. According to Mr. Shepard, three factors affect the net return on the investment. The crying need of the contractor-dealer is an adequate accounting system by which he can determine monthly the net return on his investment, gross and net profit, etc., rather than wait for the end of the calendar year when it will be too late to ward off disaster. Various estimates were made as to the duration of the present prosperity wave, which was placed at from six to nine months. A warning note was sounded as to the danger of pyramiding orders.

At the meeting given over to the central station, A. E. Holloway, commercial manager of the San Diego Consolidated Gas & Electric Company, San Diego, Calif., spoke of the success that had attended the organization of round-table meetings between the central station men and contractor-dealers, in which informal discussion of mutual problems worked greatly to the advantage of both. Mr. Holloway has developed a code of ethics for contractor-dealers and also a leaflet giving average operating costs for electrical appliances which is being distributed among consumers in his territory.

W. R. Putnam of the Idaho Power Company, Boise, Idaho, discussed the relationship between the central station and the contractor-dealer. He contrasted the volume of business done by the central stations and the aggregate sale of electrical appliances, in which the gross revenue of the former was 10 per cent less than the $1,200,000,000 gross of the latter. It is estimated that 1923 sales of electrical appliances will be $400,000,000 in excess of 1922, while the gross revenue to central stations will be about $1,200,000,000. In view of the fact that the investment of the contractor-dealer is only about one-twelfth that of the central station, these figures are interesting.

Mr. Putnam emphasized the fact that the central station is the foundation upon which all electrical business is erected and that the duty of helping the contractor-dealer toward the development of sound business methods and a greater degree of prosperity for himself should fall more properly upon the jobber than upon the central station. In his opinion, merchandising activities on the part of the central station help rather than injure the business of the contractor-dealer.

R. E. Fisher, vice-president in charge of sales of the Pacific Gas & Electric Company, San Francisco, read a paper on the value of the contractor-dealer cooperation to the central station against inimical legislation. His paper will be presented in full in a later issue of the Journal of Electricity and Western Industry.

A. C. McMicken, manager commercial department, Portland Railway, Light & Power Company, Portland, Ore., said that as soon as the contractor-dealer began to realize that his interests and those of the central station were mutual, better cooperation would result. He spoke of the improvement in standards of house wiring in the last few years, directly resulting from educational movements within the various trade organizations. He put the question, "Will the contractor-dealer of this generation develop into a competent merchandiser?"

T. E. Bibbins, president of the Pacific States Electric Company, San Francisco, attributed half his company's volume of business to the contractor-dealer. Mr. Bibbins expressed the opinion that the present high cost of wiring for electrical appliances, particularly heating devices, is placing a serious stumbling-block in the path of their wider distribution.

Messrs. Bibbins, Putnam, McMicken and Fisher all feel that unnecessary restrictions imposed by municipal regulations with respect to safety devices have increased the cost of wiring unduly. Mr. Fisher added, further, that while one solution of the high cost of wiring for the future is to see that adequate wiring is done on all new homes, nevertheless there remain many hundreds of thousands of homes throughout the country which are potential users of electrical appliances but which are either inadequately wired at present, or, in some localities, not wired at all.

The open meetings were presided over with exceptional ability by Charles Wiggin of Pacific States Electric Company, San Francisco, with Albert Elliot as secretary.

Among those present were:

T. E. Bibbins, president, Pacific States Electric Company.

D. E. Harris, vice-president and manager of sales, Pacific States Electric Company.

Charles C. Hillis, vice-president, Electric Appliance Company.

W. S. Berry, sales manager, Western Electric Company.

Earle G. Alexander, manager, Alexander & Lavenson Electrical Supply Company.

James H. Lavenson, financial manager, Alexander & Lavenson Electrical Supply Company.

Arthur E. Rowe, sales manager, Garnett Young & Company.

Clarence E. Thompson, salesman, Westinghouse Lamp Company.

W. B. Sawyer, Jr., sales engineer, United States Steel Products Company.

Walter Seaver, manager wire department, United States Steel Products Company.

R. A. Balzari, manager of industrial division, Westinghouse Electric & Manufacturing Company.

R. F. Oakes, National Carbon Company.

Ray W. Murphy, Pacific Coast manager, Westinghouse Lamp Company.

H. B. Squires, president and manager, H. B. Squires Company.

H. F. Yost, manager Trumbull Electric Manufacturing Company.

Harry L. Garbutt, manager supply division, Westinghouse Electric & Manufacturing Company.

Thomas Simpson, general manager, Majestic Electric Development Company.

Harry H. Daley, sales and heating specialist, Majestic Electric Development Company.

H. E. Sanderson, Pacific Coast manager, Bryant Electric Company.

The Denver Electrical Cooperative League has resumed its weekly radio matinees after a lapse of several weeks pending the renewal of a license for the broadcasting station featuring the programs. According to S. W. Bishop, the executive manager, talks by experts in the industry are being given every Friday afternoon from the station operated by the Winner Radio Corporation, of Denver.

Books and Bulletins

ELECTRIC TOY MAKING

By PROF. T. O'CONOR SLOANE. Twenty-first edition. 250 pages, 7¼ x 5¼ in. Cloth binding. 118 illustrations. $1.50. Published by The Norman W. Henley Publishing Company, New York.

The book is an enlarged and revised edition of former editions of the same subject. The author has added some new material to the text and has included a few new illustrations. The text is the same character as before and handles the subject in an interesting and sufficiently detailed manner.

The book deals with the making at home of toys, electrical apparatus, motors, dynamos, etc., and explains how these can be made from materials which can be obtained at little cost. Rather detailed treatment is given to various classes of alarms, both the open and closed circuit relay-types being described.

Electrical toys are the principal topics of the book and these have been dealt with in a comprehensive manner. The book is a little too complicated for a child to use, but could be followed by an adult with ease.

Meetings

Electric Truck Day to Be Held by Development League

The Electric Transportation Club of San Francisco is planning to cooperate with the San Francisco Electrical Development League in providing entertainment at the meeting of the League which opens the Pacific Coast Electrical Association Convention. The usual meeting of the League will be postponed until Tuesday, June 19, and at that time the delegates to the convention will be guests at the luncheon.

Preliminary to the lunch, the Electric Transportation Club plans to hold a parade of electric vehicles now in use in San Francisco. This parade will advance up Market Street so that it will arrive at the center of the city about noon, thus securing attention from the largest possible crowd. It is planned to have the trucks decorated with appropriate signs telling of the economy of operating electric vehicles and other sales propaganda.

Central Station Association Is Host to Denver Club

The Denver Chapter of the Doherty Men's Fraternity was the host at the annual breakfast of the Denver Press Club, held in the Colorado city on April 29. V. L. Board, president of the chapter and general superintendent of the Denver Gas & Electric Light Company, served as the principal speaker. James C. Burger, president of the Hamilton National Bank and a director of the Denver central station, acted as toastmaster. George E. Lewis, executive manager of the Rocky Mountain Committee on Public Utility Information, was a member of the club committee arranging the breakfast.

Other electrical men taking part in the celebration were John E. Loiseau and G. W. Bixler of the Denver Gas & Electric Light Company, W. C. Sterne of the Arapahoe County Power & Light Company, S. W. Bishop and F. J. McEniry of the Denver Electrical Cooperative League and J. F. Greenawalt and J. F. Moorhead of the Mountain States Telephone & Telegraph Company.

The Los Angeles Chapter, American Institute of Electrical Engineers, recently took a trip to the Laguna Bell substation of the Southern California Edison Company, where they were informed of the transfer of the Edison system to 220,000 volts. They also inspected the Arcade substation of the Pacific Electric Railway Company and then took a trip to Throop College where they enjoyed a dinner and several interesting talks.

Extension of the power line of the Stevens County Power & Light Company from Colville, Wash., through Echo Valley and Lake City to Marble is to supply a large section of the farming land with electricity this summer. The Upper Columbia Company of Marble has contracted with the power company for not less than 200 hp.

Donner Lake, where the California State Asocation of Contractors and Dealers will hold its annual meeting beginning June 10. Activities such as those shown will be engaged in by the delegates.

Contractor-Dealers Assemble at Donner Lake, June 10-16

Northern California's "Electrical Dependability Caravan" numbering approximately eighty men, women and children, will leave San Francisco in automobiles, Saturday, June 9, for Donner Lake in the High Sierra, to participate in the annual convention of the California Association of Electrical Contractors and Dealers to be held at that resort during the week of June 10-16.

This year's convention is an innovation as heretofore the meetings have been held at more conventional resorts close to the centers of population. From the number of reservations for the sessions this year, officials of the organization feel that the plan to make the convention a vacation trip is highly successful.

The party from San Francisco will be met in Sacramento Saturday night by a committee from the Sacramento section of the association, which includes C. V. Schneider, chairman, J. C. Hobrecht, R. Finchley, M. P. Cannon, and D. H. McCulloch. Special arrangements are being made for the entertainment of the party Saturday night. Augmented by the delegations from the interior valley cities, the party will leave Sacramento early Sunday morning for Donner Lake.

The convention will open with a business session Monday morning. Tuesday morning's session will be devoted to discussions of cost and business stimulation methods. Wednesday morning's meeting will be devoted to committee reports and the election of officers. Thursday the entire party will visit the resorts around the shores of Lake Tahoe while Friday and Saturday will be devoted to pleasure. The plans for entertaining the delegates are most elaborate and include dancing, fishing, swimming, boating and the annual ball game. The party will return to San Francisco, Sunday, June 17.

COMING EVENTS

National Electric Light Association—
Annual Convention—New York, N. Y.
June 4-8, 1923

League of the Southwest—
Conference—Santa Barbara, Calif.
June 7-9, 1923

California State Association of Contractors and Dealers—
Annual Meeting—Donner Lake, Calif.
June 9-16, 1923

Pacific Coast Electrical Association—
Annual Convention—San Francisco, Calif.
June 19-22, 1923

Northwest Electric Light and Power Association
Annual Convention—Seattle, Wash.
June 27-30, 1923

Rocky Mountain Division, N.E.L.A.—
Annual Convention—Glenwood Springs, Colo.
Sept. 17-19, 1923

American Institute of Electrical Engineers—
Pacific Coast Convention—Del Monte, Calif.
Oct. 2-5, 1923

The Columbia Valley Power Company, an organization of eastern men, controlling water rights on the Deschutes River, has opened an office in Portland, Ore., and is now doing preliminary engineering work looking to the establishment of two power plants. D. G. Fisher of Davenport, Iowa, president of the concern, is quoted as saying that the company is confident that the plants will be built and if all goes well, construction should begin within two years. The plan contemplates a transmission line across the Cascade Mountains into the industrial section about Portland.

Articles of incorporation were recently filed by the Inland Power & Light Company of Portland, Ore., capitalized at $100,000. The incorporators are Henry S. Gray, C. Larison, and D. A. Eckman.

Personals

E. B. Criddle, formerly general agent of The Southern Sierras Power Company, has been made vice-president of that company and the Nevada-California Power Company and general agent of the Holton Power Company. Mr. Criddle was born in Tennessee. He

E. B. CRIDDLE

had an extensive preliminary training in bookkeeping, stenography, drafting, railroad clerical work and rate making, together with considerable shop work. Following this he was for some time a public accountant and real estate agent. Later he became interested in the manufacture of ice and was for a time manager of an ice plant. He was also manager of a rolling mill and superintendent of a gold reduction works. Mr. Criddle has found the experience gained in these many branches of industry of great use in the public utility field. He joined The Southern Sierras Power Company in 1911 as district manager in the Northern Division. He held this position for two years and was then made general agent with headquarters in Riverside. Mr. Criddle is an active members of the Pacific Coast Electrical Association and every year contributes to the papers of that organization.

Parker M. Robinson, formerly turbine engineer on the Pacific Coast for the Westinghouse Electric & Manufacturing Company, has recently joined Hunt, Mirk & Company, San Francisco, entering the firm as a junior partner. Mr. Robinson is a graduate of the University of Pittsburg as well as Yale University and has been connected with the engineering department of the Westinghouse Electric & Manufacturing Company for over four and a half years. In his new work, Mr. Robinson will represent Hunt, Mirk & Company who are consulting and contracting engineers specializing in steam power plants on the western coast.

H. H. Jones, president and manager of the San Diego Consolidated Gas & Electric Company, is a recent San Francisco visitor.

Warren K. Lee, of the Northeast Electric Company, Detroit, Mich., is a recent Pacific Coast visitor.

R. M. Hendrick, erecting engineer for the Pelton Water Wheel Company, passed through San Francisco recently on his way to Philadelphia to resume his work for Wm. Cramp & Sons Ship & Engine Company. For the past six months Mr. Hendrick has been in Mexico superintending the erection of two 20,000-hp. Pelton turbines at the Tepexic plant of the Mexican Light & Power Company.

F. F. Johnson has been reelected president of the Idaho Power Company. Others elected were **William T. Wallace**, vice-president; **W. R. Putnam**, vice-president and general manager; **E. W. Hill**, vice-president; **R. B. King**, general superintendent; **F. J. Rankin**, chief engineer; **A. J. Priest**, secretary, and **A. E. Janssen**, treasurer.

H. B. Cannon, formerly in the commercial department of the Pacific Gas & Electric Company at Newman, Calif., has been made superintendent of construction with headquarters at Modesto.

George A. Campbell, general manager of the Truckee River Power Company, formerly the Truckee River General Electric Company, was a recent San Francisco visitor. Mr. Campbell discussed the interconnection between his company's system and that of the Pacific Gas & Electric Company with officials of the latter utility.

A. C. McMicken, sales manager of the Portland Railway, Light & Power Company, is a recent San Francisco visitor. Mr. McMicken was in California to make a study of development in electric water heating. He was one of the visitors at the recent Jobbers' convention at Del Monte.

R. G. Ellis, Pacific Coast representative of the American Electrical Heater Company of Detroit, has recently transferred his headquarters from San Francisco to Los Angeles, and will conduct his business from that point.

A. E. Peat, treasurer and comptroller of the San Joaquin Light & Power Corporation, Southern California Gas Company, Midway Gas Company and associated companies, has just recently returned from a trip to New York and Washington in the interest of the various companies with which he is associated.

W. H. Aunger has recently been appointed sales manager of the Electric Corporation, of Los Angeles, jobbers and distributors of electrical supplies. Prior to Mr. Aunger's present appointment, he was salesman for the Electric Corporation in the outlying territory of Los Angeles, and his excellent work in this section gained for him his present position.

Charles P. Holmes has recently joined the Los Angeles sales organization of the Western Electric Company as appliance specialist. Prior to his present position, Mr. Holmes was connected with the Havens Electric Company of Albany, New York, General Electric distributors in that section.

L. M. Klauber, general superintendent of the San Diego Consolidated Gas & Electric Company, has been elected secretary-treasurer of the California Gas Research Council. The council is the recent outgrowth of the Gas Efficiency Committee which has been operating for several years. Among its purposes are the co-ordination of the gas activities and improvement in the methods of gas manufacture.

G. F. Egeler, mechanical engineer, formerly with the Chicago, Milwaukee & St. Paul electrification, is now connected with S. Herbert Lanyon, with offices in the Call Building, San Francisco.

Gerard Swope, president of the General Electric Company, arrived in Portland on May 21, accompanied by **C. E. Emmons**, vice-president of the corporation, in charge of the manufacturing operations. They are on a tour of inspection of the company's offices on the coast and are also investigating business conditions throughout the country.

Jake Fisher, president of the Denver Association of Electrical Contractors & Dealers, has returned to Denver after several weeks at Albuquerque, N. M.

Harry G. Holabird, manufacturers' agent, Los Angeles, and representative of the Ohio Brass Company, Crouse-Hinds and other electrical manufacturers, has just recently left for the East to visit the factories of the various companies that he represents.

E. A. Shepard, general credit manager of the Western Electric Company of New York, is a recent Pacific Coast visitor in the interest of his company. Mr. Shepard attended the Del Monte Jobbers' convention and took part in the program.

Alex Hibbard, secretary-treasurer of the Denver Association of Electrical Contractors and Dealers, after an extensive eastern trip in the interests of his organization and those manufacturers whom he represents, has returned to Denver.

H. P. Slocum has recently joined the sales force of the Hawaii Electric Company of Honolulu.

E. O. Shreve, general chairman in charge of arrangements for the annual convention of the Pacific Coast Electrical Association, to be held at the Fairmont Hotel in San Francisco, June 19 to 22, will be responsible for the programing of events at that gathering. Mr. Shreve, who is San Francisco manager of the General Electric Company, is well fitted by many years of association activity to undertake this task. An extensive program of entertainment and recreation has been arranged in addition

E. O. SHREVE and MRS. SHREVE

to the usual convention business. Two of the special features of this year's convention program for which Mr. Shreve is responsible are the Western Development Conference and the "Polyphase Pageant of Progress" in which there will be two hundred costumed participants.

E. E. Brazier, sales manager of the Capital Electric Company, and **L. B. Johnson** of the Salt Lake office of the General Electric Company, have returned to Salt Lake City after an extensive trip through the East.

H. H. Manny, Seattle manager of the Baker-Joslyn Company, recently spent several days in San Francisco on business.

J. B. Carter, former district manager at Corcoran for the San Joaquin Light & Power Corporation, has been made agricultural sales engineer for the company with headquarters in Fresno. His place at Corcoran has been taken by **Fred C. Carroll,** who was formerly assistant manager at Merced.

General George W. Goethals, noted engineer, recently spent several days in Colorado Springs, Colo., making a survey of the properties of the Colorado Springs Light, Heat & Power Company in connection with the fight that company is making for a renewal of its franchise.

J. W. O'Brien, line and service superintendent of the Utah Power & Light Company in the Ogden district, has been promoted to division manager at Park City, Utah.

George Potts, for many years connected with the American Telegraph & Telephone Company in various parts of the United States, has been appointed city electrician of Modesto, Calif.

Arthur Kempston, formerly Los Angeles district manager of the Majestic Electric Development Company, has just recently become associated with **Chas. T. Phillips** as a partner in the Charles T. Phillips Company, consulting engineers of San Francisco. This company has recently opened offices in Los Angeles in the Roberts Building, with Mr. Kempston in charge, and is now ready to render special service to architects and others interested in building operations, and to prepare plans, reports, designs, specifications and estimates on electric installations of all types, heating and ventilating, illumination, plumbing and steam

ARTHUR KEMPSTON

plants. Mr. Kempston was for a number of years city electrician of San Francisco and later was a field representative of the California Electrical Cooperative Campaign. He is a very active member of the Electric Club of Los Angeles, being chairman of the membership committee.

C. M. Clark, chairman of the executive committee of the Portland Railway, Light & Power Company, recently spent two weeks in Portland going over the properties of the company which he heads. Mr. Clark's headquarters are in Philadelphia.

Frank E. Russell, general manager of the Tucson (Ariz.) Gas, Electric Light & Power Company, subsidiary of the Federal Light & Traction Company, died recently. Mr. Russell had been connected with these utility properties for 31 years and was an active figure in the utility affairs of the Southwest.

Dr. Schuyler Skaats Wheeler, pioneer electrical manufacturer and inventor, past president of the American Institute of Engineers, and the originator of the engineering "Code of Ethics," died in New York City on April 20. Dr. Wheeler was one of the organizers of the Crocker-Wheeler Company, and was the inventor of the electric fan motor. He was one of the foremost figures in the electrical industry.

W. R. Putnam, vice-president and general manager of the Idaho Power Company, is a recent California visitor. Mr. Putnam also attended the recent Jobbers' convention at Del Monte.

A. E. Holloway, sales manager of the San Diego Consolidated Gas & Electric Company, attended the recent Del Monte convention of the Jobbers' Association and took part in the discussions.

J. H. Parker, head of J. H. Parker & Company, Parkesburg, Pa., manufacturers of porcelain, is a recent Pacific Coast visitor. Mr. Parker was a visitor at the sessions of the Pacific Coast Jobbers' convention at Del Monte.

F. C. Plueger, of the Atlas Electric Sign Corporation, New York City, is a recent Pacific Coast visitor.

M. G. Soldini of the Schenectady works of the General Electric Company, is a recent San Francisco visitor.

Harry Byrne, manager of the North Coast Electric Company, Seattle, attended the quarterly meeting of the Pacific Coast division of the National Electrical Supply Jobbers' Association at Del Monte recently.

Henry C. Peeples, formerly with the Puget Sound Power & Light Company and for several years attached to the engineering division of Stone & Webster, has gone to Indianapolis, Ind., where he will be engaged in the construction of a 75-mile steel tower transmission line from Indianapolis to Terre Haute.

C. S. Anderson, formerly electrical engineer for the Duquesne Light Company, Pittsburg, Pa., is now connected with the Electric Bond & Share Company, New York.

R. C. Lanthier, vice-president and general manager of the Sangamo Electric Company, Springfield, Ill., spent several weeks on the Pacific Coast recently, spending several days in both San Francisco and Los Angeles.

R. W. Coblentz has taken over the Pacific Northwest territory for the Square D Company and has established headquarters in Portland. He will work under the direction of **E. S. Conrad** of San Francisco.

H. W. Coombs, sales representative of the Bryant Marsh Division of the National Lamp Works, spent two weeks in Salt Lake City recently in the interests of his company.

Frank D. Fagan, who has been associated with Thomas A. Edison as vice-president and general manager of the Edison Storage Battery Company for the past three years, has been selected to go on a special mission to Japan for the International General Electric Company. Mr. Fagan has risen up through the ranks of the General Electric Company, and is the originator of many remarkable selling ideas in connection with the sale of incandescent lamps. He originated "Edison Day" which has since taken on a national character. It was through his efforts that Thomas A.

FRANK D. FAGAN

Edison was induced to come to the Panama-Pacific International Exposition in San Francisco, in 1915. Mr. Fagan sailed on May 17, and will stop at Honolulu en route to Japan on company business. Mr. Fagan is well known in the West, having spent the first years of his connection with the electrical industry in some of the western states.

R. M. White has been appointed service station manager of the Los Angeles station, Edison Electric Appliance Company. Mr. White has been in the employ of that company for the past two years and succeeds H. E. Corbett, deceased.

Ross Hartley, president and manager of the Electric Corporation, jobbers and distributors of Los Angeles, is now in the East visiting the various factories which his company represents in this section.

Obituary

Charles A. Kilbourne, president of the Kilbourne & Clark Manufacturing Company of Seattle, died at Nyack, N. Y., recently. Mr. Kilbourne was a pioneer of Seattle, having established the Seattle Electric Company which was taken over by the Stone & Webster interests. In 1900, he organized the Kilbourne & Clark Manufacturing Company of which he was president. This company was the pioneer in the Pacific Northwest in the development of wireless and radio telegraphy equipment manufacturing, and held important contracts for wireless apparatus for government ships during the war.

Manufacturer, Dealer and Jobber Activities

Harold Danenburg, of Roswell, N. M., has recently purchased a half interest in the Bonney Electrical Company of that city. Mr. Danenburg was formerly with the L. F. Woodhead Electrical Company.

The Westinghouse Electric & Manufacturing Company has recently placed on the market a new device for indicating the temperature of oil in distribution transformers. The new device is known as a transformer thermal indicator. The new indicator may be used on any oil-insulated electrical apparatus and is designed to indicate accurately actual temperatures as well as maximum temperatures. The device can be attached to transformers with a minimum of labor.

The electrical fixture store of Stanley Lutz, formerly located at 200 Chamber of Commerce Building, Portland, Ore., has been moved to a large ground floor storeroom at 108 Third Street. This gives Mr. Lutz greatly improved storeroom and factory facilities. B. E. Lyman, expert metal finisher, who recently arrived from the East, has been added to the personnel of the store. He is creating a number of new finishes for appliances turned out.

The National Electric Company of Butte, Mont., has recently added an art department to its store. In the new department the company handles an attractive and up-to-date line of garden pottery shades and shields as well as other ornamental fixtures. The part of the store devoted to the fixture department is so arranged as to permit purchasers to simulate conditions in their own homes while looking at new fixtures. Mahogany and old ivory woodwork makes the new art department an attractive addition to the store.

The Roller-Smith Company, New York, has recently published Bulletin No. 30 which describes the new triplex ammeter that the company is just putting on the market. The new ammeter is designed for taking simultaneous readings in each of the three phases of a three-phase high tension metering circuit. The new ammeter can be used in low tension three-phase circuits in connection with suitable current transformers. According to the booklet just published the triplex ammeter has all the advantages of three individual ammeters, as any of the three mechanisms can be removed without interruption of the circuit.

The City Electric Company is a new store recently opened in Sheridan, Wyo. R. L. Cooley is the manager of the new concern which will handle a line of electrical fixtures and appliances. The store is located at 18 South Main Street.

The Square D Company, Detroit, Mich., has developed a new device to make safety switches additionally safe. The new device encloses the live terminal, entering the safety switch, in a protective cover. This cover has a narrow slot large enough to admit the switch blade but too small to permit a finger to slip through.

The Easiest Way Manufacturing Company, Sandusky, Ohio, has announced a new oscillating-type electric washing machine. The new machine has a capacity of six sheets and the tub is heavy tin-lined copper. A swinging reversible wringer is attached to the machine.

The D. & E. Electric Company has opened a new store at 5108 Geary St., San Francisco. F. J. Dolly and F. J. Egan are the owners of the new establishment which will deal in electrical fixtures and Edison mazda lamps.

The American Spiral Pipe Works, Chicago, Ill., manufacturer of steel pipe fittings, has recently published Catalog No. 22. This catalog describes in detail the spiral pipe manufactured by the company, giving illustrations of the company's products.

Altorfer Brothers Company, Peoria, Ill., has recently put on the market an electrically heated and operated ironer which is designed for the small family. The new all-electric ironer is 26 in. wide and the cost of installing it should be very small. The heating element is rated at 1,500 watts.

The Electric Corporation of Los Angeles has leased a large part of a building at 321 Occidental Avenue, Seattle, Wash., and will conduct a general electrical business in the location. Extensive alterations to the building are being made.

The Edwin F. Guth Company, is the name of a new St. Louis, Mo., company which has been formed to succeed the St. Louis Brass Manufacturing Company and the Brascolite Company. The interests of both of these latter companies have been unified under the new company. The St. Louis Brass Manufacturing Company was organized in 1902 and the Brascolite Company was formed to market Brascolite products in 1913. The company which took over these other concerns, which were both headed by Edwin F. Guth, will be presided over by the same man. No change in policy or personnel is reported.

Benjamin Electric Manufacturing Company, New York, has published Bulletins No. 705 and 708 which describe Benjamin-Starrett dead front panel boards and Benjamin outlet box fittings. Illustrations of the equipment are presented in each bulletin.

The General Electric Company has prepared for distribution, to its customers, two indexes which contain a full listing of the bulletins issued by the company. The indexes give a listing of all bulletins of supply parts, descriptive bulletins and sheets that have been prepared for distribution. From these indexes a customer can secure the number of any piece of literature that he desires and can request copies by giving the number of the publication. A list of sales offices is also included.

The Bluebird Electric Shop, Tacoma, Wash., has moved to a new location at 1105 Broadway in the Puget Sound city. The new quarters are much larger than those recently vacated. D. D. Flenner has been appointed sales manager of the concern.

The P. A. Geier Company of Cleveland, Ohio, has been holding a series of group conferences with its salesmen instead of having the usual annual sales convention. During the conferences the salesmen were told of the workings of the credit department and efforts were made to give the men a broader background of understanding of the business.

The Edison Electric Appliance Company, has been marketing for some time a line of apartment house electric ranges. These ranges are small in size and are well adapted to use in small kitchens. No nickle is on the new type ranges and all the metal is finished in plain black japan enamel.

The Master Light & Fixture Company of Auburn, Wash., has been organized with a capital stock of $40,000. The officers are: A. F. Netzel, president; A. F. Anderson, vice-president and factory sales manager; F. T. Jenks, vice-president and secretary.

ART'S FOLLIES

The above caption was suggested by our intrepid staff camera man who secured this picture at enormous expense and only after great personal risk at the annual convention of the California State Association of Electrical Contractors and Dealers, at Santa Cruz in 1922. We offer it as indisputable evidence that "Art" Rowe, besides being one of the most popular members of the electrical industry in California, is also there with the ladies.

Trade Outlook

San Francisco

General business conditions in San Francisco continue to be good and a general feeling of prosperity is prevalent. Conservative financial houses are issuing warnings against the dangers of the present upward price trend and are advising business firms to advance slowly. Commerce is active and it is the desire of the conservative bankers to prevent the recurrence of the war-boom depression and collapse.

Production and sales continue to keep ahead of 1922 records. April reports show that there was an advance of about 20 per cent over last year's production and sales. Steady demands have forced prices of manufactured goods to a higher point as have the scarcity of some raw materials and labor wage increases. Turnover in products is keeping pace with production in all lines.

The building boom has brought in the last two months a rise in prices of materials of about 15 to 20 per cent. This has resulted in the deferring of the building of new apartment houses. Construction of homes continues at a rapid rate.

The electrical industry is profiting by the building program and is in a good position. Most of the new homes being erected are being wired in the most modern manner and many follow closely wiring plans of the electric homes displayed in the region.

Seattle

The lumber industry in the Northwest has been mildly disturbed during the past three weeks by an incipient strike in the logging camps of the Puget Sound district, fostered by the I. W. W. interests. The strike was not a success, and most of the workers who walked out have gone back to their jobs. A few camps were closed, others were somewhat crippled, but no serious losses to the industry resulted in the strike fiasco. Lumber demands continue very active, and lumber manufacturing plants are working to capacity. Cargo shipments have been very heavy.

Seattle retail trade has continued in good volume, in practically all lines of merchandise. Electrical men report that the sales of all household appliances have held up satisfactorily, with a special run on appliances suitable for gifts. Electric ranges are showing considerably increased sales volume,—especially for new apartment structures. Radio sales have dropped off, and interest in this branch of electrical business seems to have waned considerably.

Prices are steady, and collections continue fairly good.

Building activities in the city show no sign of decrease, rather there is a steady increase in the number and value of permits. Figures compiled by an authoritative realtor indicate that there are now twelve million dollars worth of building work under way in the business district alone. In addition, an unprecedented number of new houses are under way or projected for the spring and summer. Of interest to the large builders is the statement that on May 12, the transcontinental railroads announced a deep cut in westbound export rates on iron and steel articles from Chicago.

Los Angeles

Building operations in the city of Los Angeles for the first week of May show the issuance of 1,600 permits with an estimated valuation of $5,020,360, while for the same period in the month of April, there were 1,578 permits issued, with a valuation of $5,115,000. From these figures it is apparent that the building for May will equal, if not exceed that for the month of April. Building during the month of April exceeded that of all other months for the present year with the exception of March.

Bank clearings for the period May 5 to 11 inclusive, show a total of $133,076,344 while for the corresponding period in 1922, clearings amounted to only $98,085,645. This shows an increase of this year over last of approximately 35 per cent.

Manufacturers and wholesalers of electrical apparatus and supplies report business increasing in volume with the only drawback being due to delays in shipment and corresponding long deliveries. The retail business is holding up well though the sale of radio apparatus has fallen off to some extent, however this is to be expected with the approach of hot weather.

Denver

Building operations as represented by residence construction continue at a record rate. Permits issued during the past month exceed a million and a quarter dollars. There seems to be no difficulty in financing and unless the unforseen occurs, it is generally believed that the building program in this territory will not slacken until fall.

Next to Kansas City, thus far this year, Denver has done more building than any other city in the tenth federal reserve district. In savings accounts Denver leads all other cities in this district. Banks in the agricultural districts report an improved condition which indicates that fair crop prices will materially re-establish business in the rural regions.

Denver is fourth from the top in thirty-eight cities where employment conditions have improved and a digest of the district according to government reports shows an increasing demand for skilled labor, mechanics, and farm hands. Clerks and office workers are not faring so well.

Central station improvements continue throughout the district. Wire and transmission materials seem to be most in demand. Jobbers report stocks in fair shape with a dull movement of appliances. In the southern part of the state, electric ranges are moving in volume. Radio trade is slow thus resulting in temporary price cutting campaigns. Commercial lighting units are being pushed successfully. Collections are still slow.

Salt Lake City

General business improvement in this section, and particularly in Salt Lake City, has been pronounced during the past few weeks. A number of new industries are contemplating locating here, and several of them are now in operation. The industrial department of the Salt Lake Chamber of Commerce, reports improvements in this line that will amount to about $2,000,000 per year in payrolls and will employ about 1,200 additional men and women. This is in addition to new projects which have not yet assumed definite form.

With the farmers, indications are good for at least fair prices this year, and there is a spirit of optimism in the agricultural districts. Constantly increasing activity in metal mining and in building is creating a heavy demand for labor, both skilled and unskilled. An extensive program of highway construction is now under way, which will involve an expenditure of about $2,500,000.

Electrical jobbers report conditions as continuing to show improvement, with this year's business to date considerably in excess of that of last year's corresponding period. Increased industrial activity is resulting in greater use of electrical energy; and in the homes also there seems to be a tendency toward the more extensive use of electrical appliances.

Credit conditions and collections continue to improve.

Portland

The principal factors in the business life of Portland and vicinity show a very healthy condition. Business generally is good. In the lumber industry, which stands first of all in the northwest, production continues at about 12 per cent above normal. Production of logs and lumber were reduced slightly during the first two weeks of May by a half-hearted strike attempted by the I. W. W. By the middle of the month, however, conditions had returned to normal. The small effect of the I. W. W. was probably due to the strong organization of loyal men known as the 4 L's (Loyal Legion of Loggers and Lumbermen).

Lumbermen are expecting the present rush of orders to continue.

Although throughout the country generally, including some of the Pacific Coast cities, the totals of the building permits for April were considerably less than for March of this year, Portland was able to show a gain of 45 per cent. Home building is going on in every part of the city, and this is in spite of high costs of material and labor shortage.

The condition of Oregon's wheat crop on May 1 was rated at 95 per cent normal. It suffered very slight winter damage. The same holds for the live stock in the state. Spring weather was very favorable to the planting of spring crops.

Construction News

Bridges

Calif., Pasadena—W. P. Earle, city engineer and superintendent of streets, has ordered the preparation of plans for the new $100,000 reinforced concrete bridge to supplant the present condemned bridge across the Arroyo Seco at Linda Vista Ave.

Calif., Santa Barbara—County Surveyor Owen H. O'Neill has been instructed by county supervisors to prepare plans and specifications for a bridge across the Santa Ynez River, on the Lompoc-Harris station road. The construction is conditional upon the voting of $215,000 for paving a 7-mile stretch of roadway in the Lompoc permanent road improvement district.

Wash., Ellensburg—The Union Bridge Company of Portland was the successful bidder for the contract to build a new steel bridge across the Yakima river between Cle Elum and South Cle Elum with a bid of $49,897. This contract includes the approach on the Cle Elum side of the river but not the concrete approach on the South Cle Elum side.

Wash., Seattle—The Washington Engineering Sales Company, here, received contract for furnishing steel for a proposed 17-ft. combination steel bridge to be built near Nome for the Alaska Railroad Commission. Contract provides for approximately 27 tons.

Wash., Seattle—By a narrow margin, the bond issue of $500,000 for erection of the Montlake-Stadium bridge, connecting the University district with downtown business streets, was passed recently.

Wash., Seattle—The King County Commissioners have appropriated $40,000 to be used in constructing the proposed bridge across Lake Washington from Barnaby Point to Enatai Point, connecting Mercer Island with the east shore of the lake.

Highways

Calif., Visalia—J. A. Dowling, of San Francisco, was awarded contract for the surfacing of the Lindsay-Tulare highway, a two-mile stretch, on a bid of $12,161.60. T. A. Hanrahan, of Fresno, received contract for a section of Dinuba highway on a bid of $53,545.72.

Calif., Oroville—Chas. L. Ellis was awarded contract for construction of west Liberty road, on his bid of $10,471.

Idaho, Boise—The state department of public works has awarded to J. C. McGuire of Boise the contract for the construction of 6.78 miles of paving of the Yellowstone Park highway in Bingham County. The cost of the project will be $211,787.27, which will be borne by the federal government, state and county. The construction will be bituminous concrete on a gravel foundation.

Idaho, Boise—A contract has been let for 5.5 miles of the Coeur d'Alene-Yellowstone trail in Shoshone County at a cost of $60,000. This is a federal aid project. Shoshone County is planning to complete the highway across the county, a distance of 38 miles.

Idaho, Boise—The state department of public works has let a contract for the surfacing of part of the North and South highway between Cottonwood and Lawyers Canyon in Idaho County. The highway will be surfaced with crushed rock for 1.22 miles, the contract being awarded to the General Construction Company for $46,002.

Mont., Helena—Contracts for approximately $550,000 worth of highway building on the Blackfeet Indian reservation will be let by the state highway commission early in June, now that the right-of-way matters have been settled. George W. Lannstrum made the announcement. Fully 100 per cent federal funds will be used for the building of this highway which will be about 55 miles of road. The road will extend from Birch to Glacier Park.

Ore., Salem—Highway contracts have been let as follows: 24 miles of construction work on the Eugene-Florence road through the Suislaw national forest of Oregon was awarded to Guy F. Atkinson of Portland on his bid of $366,835. The project will include clearing, grading, crushed rock and gravel surfacing and bridge construction. The contract for 7.9 miles of crushed rock and gravel surfacing on the McKenzie highway in the Belknap section of the Cascade national forest was awarded to the Motor Investment Company of Portland for $32,210. The contract for 9.75 miles of clearing and grubbing work on the Olympia highway between Bogachiel and Hoh River was let to Tilenda, Slimkoski and Early of Wilkeson, Wash., on a bid of $58,678 with explosives furnished by the contractor.

Wash., Walla Walla—On a bid of $32,792 H. L. Wilson was awarded the contract for the construction of 9.2 miles of macadamized highway on the lower Waitsburg road between Bolles Junction and Dry Creek.

Wash., Seattle—Contract for paving 16th Avenue S.W. highway known as the White Center road, has been let by King County commissioners to Florito Bros., Seattle, on their bid of $31,400. The road is one mile long, and one-course concrete, 20 ft. wide and 6 to 8 in. thick will be laid.

Wash., Olympia—State highway commission will receive bids until June 12, for the following work: Grading, graveling 5 miles of Sunset highway, King County, Falls City to Snoqualmie; graveling 15 miles of the Ocean Beach highway, Pacific County, between Palix and Nasel; Olympic highway, Grays Harbor County, pacing four small gaps between Montesano and Aberdeen, and until June 25, for grading, draining and surfacing with crushed rock, 6 miles of Navy Yard highway, Mason County, between Union City and Holyoke.

Irrigation Projects

Ariz., Phoenix—Plans for the formation of a project to be known as the Roosevelt Irrigation District No. 1, were completed recently before the Maricopa County supervisors. The project comprises the Carrick and Mangham Agua Fria Lands & Irrigation Company properties, approximately 20,000 acres, which with the holdings of 115 individuals total 39,000 acres. The water supply will be obtained by diverting the unappropriated and flood waters of the Gila and Agua Fria rivers, installation of pumps within the district and from surplus waters of other irrigation districts. Directors are: C. Rodney McDonald, S. Carl Miller and T. J. Roberts.

Calif., El Centro—Chief Engineer R. S. Carberry of the Imperial Irrigation District, states work will be started soon on construction of a large drainage canal in the Westmoreland district. The survey will be completed in 60 days. Work, to be done under the recent $7,500,000 bond issue, will be started not later than Sept. 1.

Idaho, Boise—The voting of the $2,750,000 bond issue and approval of the contract with the reclamation service by the districts, including the North Side Twin Falls and the South Side Twin Falls projects, will make available $10,000,000 for the construction of the American Falls reservoir. Lands in the American Falls reservoir district comprise approximately 500,000 acres, virtually all now occupied and farmed. The present town of American Falls is to be submerged with the construction of the reservoir and will be relocated on higher lands.

Mont., Helena—Award of the construction contract of the Re-Lodge-Rosebud irrigation district to J. S. Haley of Bozeman for $217,000 was approved by the state irrigation commission.

Mont., Great Falls—When the present government plans are carried out 398,000 acres of the Indian reservation in northern Montana will be put under irrigation. On the Flathead reservation 138,500 acres will be irrigated; 107,500 acres on the Blackfeet reservation and 152,000 on the Fort Peck reservation are to be watered.

Nev., Yerington—The contract for building of the Bridgeport dam on the east fork of the Walker River has been awarded to C. H. Hill of Reno by the Walker River irrigation district for $153,400. Materials are to be furnished by the district. Work is to start at once.

Ore., Albany—Storm sewers are planned by the city to drain 436 acres and to cost approximately $55,000. The firm of Stevens & Koon of Portland are the engineers in charge. The sewer is proposed to be 30 ft. deep at the river end and from 10 to 14 ft. deep at the end of the branches. The lateral sewers will be built at the expense of the property owners but the main line will be built entirely by the city.

Wash., Walla Walla—Immediate construction of the wing dam on the north bank of the Snake River is now permitted, upon word received from O. C. Merrill, executive secretary of the Federal Power Commission, by Harry Phelps, manager of the Burbank irrigation district and by Dr. J. W. Summers, representative of the fourth congressional district. Lumber and material for the dam are ordered and construction will begin as soon as the river recedes. The dam will be in operation this year, thus saving, said officials of the district, costs of about $30,000 for power annually. The pumping plant and the water right will increase the value of approximately 9,200 acres.

Wash., Olympia—State division of hydraulics, Marvin Chase, supervisor, has granted application for appropriation of the waters of the Klickitat River for a big irrigation project to be constructed by the Grand Dallas Irrigation Canal Company. The project will comprise 5,190 acres, and is estimated to cost $300,000.

Power Plant Equipment

Wash., Olympia—The Olympia Light & Power Company is making extensive changes in its lines and plant. The trolley wires will be supported from buildings instead of from poles and a new 100-hp. generator will replace the old 60-hp. machine. Two new water wheels, each capable of developing 1,000 hp., and a $5,000 control switchboard will be included in the new improvements.

Power Projects

Ariz., Douglas—A power plant costing in the neighborhood of $250,000 is to be constructed in Cananea by the Pedrazinis for the Las Chispas mine, near Arizpe, according to information given Alfred Paul, who has just returned from that district. A corps of engineers is now surveying for the transmission line.

Wash., Walla Walla—Surveys have been completed, and actual construction work will be under way shortly on the high tower transmission line of the Pacific Power & Light Company, extending from Kennewick to Pendleton, and on down the Columbia River to the plant at Hood River. The new line will carry 60,000 volts, and approximately $350,000 will be spent in the improvement.

Railways

Calif., Bakersfield—Southern Pacific Railway has been authorized by Interstate Commerce Commission to construct a 21-mile road starting 7 miles east of Bakersfield from the main line of the Southern Pacific and entering the Arvin and Weed Patch districts, 22 miles southwest of Bakersfield. Estimated cost, $500,000.

Calif., Mojave—Utah Construction Company, Phelan Building, San Francisco, was awarded contract by Southern Pacific Railway for the construction of 12-mile second track from Mojave, Kern County, to Camerson, Kern County. Work involves 85,000 cu. yd. excavating. Work in charge of engineering department, San Francisco.

Mont., Great Falls—Nearly $2,500,000 will be expended in Montana this year by the Great Northern Railway Company for new construction, repairs and replacements, according to President Ralph Budd, who with a number of other officials of the road stopped in Great Falls, on his western inspection trip. The improvements to be made in Montana in 1923 include 19 miles of new double track between Java and Nyack, to cost $1,500,000; enlargement of engine facilities, shops, terminals, and car repair depots at Great Falls, Whitefish, Cut Bank, Troy, Rexford and Havre; relaying track, replacing bridge trestles and culverts, and placing concrete linings in tunnels.

Utah, Ogden—The Utah Construction Company has closed a $6,000,000 contract with the Southern Pacific Railroad Company of Mexico for the construction of trackage between Tepic and Laquemada. This link is part of the line which will connect Nogales with Mexico City via the West Coast.

Street Lighting

Calif., Long Beach—C. W. Sparks, 457 S. Lake St., Los Angeles, was the low bidder and was awarded contract at $19,945 for constructing an ornamental lighting system on Anaheim St. from American Ave. to Daisy Ave.

Calif., Los Angeles—H. H. Walker, 1800 W. 12th St., submitted low bid to board of public works at $27,861 for constructing ornamental lighting system in 16th St. between Figueroa and Hoover Sts.

Calif., Anaheim—Street paving contracts involving the expenditure of more than $127,000 were awarded by the Anaheim city council for work on boulevards in Mills Park, on Helena, Zeyn, Walnut, Sycamore, Citron and West streets and on several alleys in the business section of the city. The Griffith Paving Company was awarded the contract for all work except that of paving the alleys, which will be done by the Edwin B. Garretson Company of Long Beach.

Calif., Sacramento—City improvement bonds aggregating $1,172,000 were approved at the recent election, providing for the removal of Y-street levee, street improvement extension of fire and police alarm systems, Sixteenth-Street subway, boulevard paving, levee revetment work, extension of water mains, sewer extension, increase in fire equipment, auditorium, garbage plant, and Twelfth-Street subway foot-path.

Ore., Portland—The city paving plant was the low bidder on all street paving projects, and made a clean sweep of the contracts. Nine projects totaling $55,246 were awarded.

Ore., Roseburg—The contract for the installation of the city's new street lighting system was let to Harold Hudson, local electric dealer. Roseburg's present street lights are to be scrapped and a complete new system installed. The new type will be a single globe and 400-cp. lamp on a 13-ft. pole. The installation will cost the city $10,800.

Utah., Ogden—The Ogden city commission has awarded to the Union Construction Company the contract for the paving of the ten blocks of district No. 141 with 5-in. concrete base and 2-in. black top at $116,189. The work upon the district will start at once, according to the announcement of W. E. Roche, general manager of the company.

Streets and Sewers

Wash., Seattle—Contract for constructing a tunnel in First Avenue South, under the Duwamish Waterway, has been awarded to R. L. Spargur, Colman Block, for $107,582. Work involves sinking shaft 137.5 ft., driving tunnel 400 ft.; shaft lining, 400 cu. yd.; tunnel lining, 500 cu. yd.

Wash., Seattle—Contract for sewers in East Marginal Way District has been let to F. N. Badolato, Seattle, on his bid of $124,321. Work involves laying approximately 22,000 ft. of clay sewer pipe, 12 in. to 36 in. in size.

Wash.,Seattle—Only one bid for sewers in Brandon Street, et al, submitted, that of F. N. Badolato, at $70,984 for clay and $69,683 for concrete pipe. Bid was rejected and new bids will be called; engineer's estimate, $54,965.

Wash., Aberdeen—Hankell, Hegg & Company were awarded the contract for the paving of Alder Street on a bid of $29,980.

Waterworks

Calif., Yuba City—At a recent election held, bonds totaling $40,000 carried for water works extensions and care of paved streets, the waterworks extension bonds of $32,000 going through without a dissenting vote.

Calif., San Francisco—Of bids submitted for furnishing pipe for the 20-mile conduit from Irvington, Alameda County, and Crystal Springs Lake, San Mateo County, the Western Pipe & Steel Company submitted the lowest at $19.72 per foot. On this basis it is estimated that the cost of laying the conduit will be about $2,235,000, which is approximately $50,000 below the estimated cost. Contract was awarded by the San Francisco board of public works.

Ore., Portland—Preliminary steps are to be taken for the construction of the third conduit from the Bull Run head works to the city. This line will be 30 miles in length and will follow a different route from the other two lines. It is probable that Commissioner Mann will advertise for bids by July 1. A rough estimate places the cost at $1,000,000.

Wash., Enumclaw—At a recent city election, a bond issue of $100,000 for purchase and improvement of a municipal water system was passed by the voters.

Wash., Camas—The city council recently purchased from the Camas Water Company the existing water system, and will immediately expend $100,000 in improvements and extensions to the system. Work includes laying eight miles of cast iron pipe; a small diversion dam and intake; small additional city reservoir and improvements to the distribution system. Plans will be completed and ready for bids in about 30 days. Stevens & Koon, consulting engineers, Spalding Building, are in charge of the work.

Wash., Pe Ell—At a recent city election, it was voted to purchase and improve the water system now operated by the Washington Pipe & Foundry Company. Bonds in the sum of $30,000 were voted for the purchase.

Wash., Tacoma—City water department will expend $72,000 in replacing with iron mains the wooden mains in South J. Street district.

Miscellaneous

Calif., Merced—Hunt Engineering Company, Kansas City, has the contract to erect a cement plant on property along the Merced River, at the mouth of Jenkins Gulch, for Yosemite Cement Co., composed of middle-west men, who will expend approximately $1,000,000 on present undertaking. The purchase of the line output has been contracted for by the Agricultural Lime & Compost Co., American National Bank Building, San Francisco. J. E. Monroe is one of the officers. The cement company has secured 1,500 acres in the San Joaquin Valley, additional to the Merced River holdings.

Buildings (Industrial)

Calif., San Francisco—Preliminary work on the construction of two additions to the present plant of the American Can Company on Third Street, between 20th and 22nd Streets, will start at an early date. The estimated cost is $1,000,000. One building will be devoted to manufacturing and storage and will be built on a lot 200 by 225 ft. It will be a two-story reinforced concrete structure. The other will be a three-story office building on a lot 80 by 180 ft. The general factory offices of the company's plant will be located here. Provision is also being made for a cafeteria and locker rooms for employees. C. G. Preis is chief engineer of the company.

Calif., Los Angeles—Arthur Walker, 1335 E. Adams St., has had plans prepared and will erect a factory building on Traction Ave., near Hewitt St., for himself. It will be 2-story, 50 x 140 ft., brick walls, composition roofing, cement and wood floors, metal skylights, steel sash; $20,000.

Calif., Los Angeles—Joseph F. Rhodes, 415 Central Building, has the contract to erect a 1-story factory building on Newton Street, near Alameda St., for the Tropical Preserving Co., 2333 Enterprise St. Brick construction, 70 x 120 ft., composition roofing, metal skylights, cement floor; $15,000.

Glendale, Calif.—The Rogers Una-Drive Motor Truck Co., H. C. Powell, treasurer and general manager, has taken a 98-year lease on 9 acres near Colorado Blvd. and San Fernando Road, Glendale, where it expects to begin construction immediately of the first unit (about 150,000 sq. ft.) of a large motor truck factory. The lease was negotiated with the Roy L. Kent Company, 130 S. Brand Blvd., Glendale, which will probably handle the architectural and engineering work.

Calif., Huntington Beach — California-Pacific Textile, Inc., with a capital of $1,500,000, will build a 10,000 spindle cotton mill for the manufacture of auto tires, cord, farbics and other similar products. W. A. Golden, formerly of Providence, R. I., is president and Thomas Talbert, Huntington Beach, chairman of the board of supervisors of Orange County, is one of the directors.

Calif., Los Angeles—Architect John M. Cooper, 320 Marsh-Strong Bldg., is preparing plans for the first unit of the class A warehouse to be erected on McGarry St., between 8th and 9th Sts., for Ray H. Arnold. It will be 5-story, 135 x 220 ft., reinforced concrete construction, plaster exterior, composition roofing, steel sash, metal skylights, sprinkling system, steel rolling doors, 4 freight elevators; $400,000.

Calif., Los Angeles—Architect W. L. Schmolle, San Francisco, is preparing plans for a 3-story class A warehouse, to be erected at 15th Street and Grand Avenue for Chansler-Lyon Company. Noice & Merrill, 1326 Washington Building, have been commissioned structural engineers. Reinforced concrete construction, 3-story and part basement, dimensions 70 x 170 ft., mezzanine floor, concrete exterior walls, composition roofing, 2 freight elevators, steel sash, steel rolling doors, ornamental iron, wire glass; $100,000.

Idaho, Boise—A concrete warehouse is to be erected for the W. P. Fuller Company in this city at an estimated cost of $100,000.

Ore., Portland—Portland business men under the direction of the Industries department of the Chamber of Commerce, headed by Max H. Hirsch, have subscribed an issue of $175,000 in bonds to erect a mammoth four-story reinforced concrete building adjacent to the Southern Pacific shops in the Brooklyne district to house the new plant of the Grand Rapids Show Case

Company. This company plans spending approximately $600,000 in its new plant and its annual output will be of a value of $2,000,000. Approximately 400 high grade mechanics will be employed.

Wash., Wenatchee—Construction of a $100,000 warehouse and office building, to house the Wenatchee branch of the Powell-Saunders Wholesale Grocery Company, will be started in the near future, it is announced by Glenn B. Pewell, vice-president of the company.

Wash., Seattle—Warehouse—Frederick & Nelson, department store, and F. S. Harmon Company, furniture manufacturer, plan the erection on Westlake Avenue of two warehouses, at a combined cost of $750,000. One structure will be 6 to 8 stories high, while the other will be 4 stories.

Buildings (Miscellaneous)

Calif., Los Angeles—Bank—Architects Walker & Eisen, 325 Pacific Finance Building, are preparing plans for a 13-story class A bank and office building to be erected on south side of 8th Street and extending from Main St. to Spring St. The site has been purchased by a local syndicate including J. B. Lilly, Paul B. Fletcher, Geo. H. Woodruff, Milton Kauffman, A. R. Walker and P. A. Eisen. The first floor, mezzanine and basement will be occupied by a new bank and each of the upper stories will contain 18 offices. Cost, $1,000,000.

Calif., Los Angeles—Hotel—Fred Siegel, 414 Chapman Building, has purchased a lot on the west side of Figueroa Street between 5th and 6th Streets, and contemplates the erection of a 14-story class A reinforced concrete hotel building. The site is 60 x 165 ft. and the new building will cost $1,000,000.

Calif., San Francisco—Hotel—Plans are being prepared by Bliss & Faville, architects, for the Post Street wing of the St. Francis Hotel. Present plans call for construction of two basement stories and two stories above the street, with foundations which will permit of ultimately running the structure up to 13 stories; $2,000,000 in bonds will be issued by the Crocker Hotel Company, of which $600,000 will be used for the wing construction, $900,000 will be reserved for later additions to the wing, and $500,000 will be used to retire outstanding bonds.

Calif., San Francisco—School—The board of public works has advertised for bids, to be received June 6, for the construction of the new Francisco school at Powell, Francisco and Chestnut Streets. The building, which will contain 21 classrooms, will cost approximately $272,000.

Calif., San Francisco—Plans for the expenditure of $300,000 in the construction of two-story homes on 33rd Ave., between Fulton and Cabrillo Streets, have been announced by Oscar Heyman & Rothert.

Calif., San Francisco — Nurses' Home — Plans for the construction of a new nurses' home, costing approximately $500,000, to replace the present structure on Sutter Street, between Scott and Divisadero Streets, were recently announced by J. B. Levison, president of the Mt. Zion Hospital. The building will be a class A structure, 6 stories in height, and will have accommodations for 115 nurses. The present building will be razed and work on the new structure will start within two months.

Calif., Santa Ana—School—The $160,000 grammar school bond issue carried at the recent election. The former bond issue was rejected by bond buyers on the ground of technical error.

Calif., Los Angeles—Stores — Offices — Walter P. Temple and Milton Kauffman, Title Insurance Building, have purchased 300 acres east of San Gabriel and will establish a townsite to accommodate 5,000 people. A 2-story class C business building will be erected upon each of the four main corners in the business district. The cost will be $200,000. Walker & Eisen, 325 Pacific Finance Building, are the architects. The new city will be called the Town of Temple.

Calif., Van Nuys — Offices — Work will start shortly on the new office building for the Southern California Gas Company. It will be located on the south side of Sylvan St. between Sherman Way and Sylmar St. and will be 1-story, 50 x 140 ft. The building will conform to general style of the company's office buildings, having two stone columns in the facade. The company has issued a $5,000,000 improvement program for Southern California.

Calif., Los Angeles — School — The Cumnock School of Expression has purchased a square of the old Hancock Ranch, bounded by Third St., McCadden, Los Palmas and Second Street, on which construction will start at once. The buildings will follow early English architecture and will be constructed in the form of a hollow square. Estimated cost, $200,000. Arthur S. Heineman, architect.

Calif., Los Angeles—Church—Final architectural drawings have been approved and accepted, and construction will start immediately on the new St. Vincent's Church. The structure will be located on the northwest corner of Figueroa and Adams Street. Cost is estimated at $1,500,000, which includes the purchase of the property and erection of parochial residence. Albert C. Martin, architect.

Calif., San Francisco—Club — The Woman's Athletic Club is planning the improvement of the lot adjacent to its present site on Sutter Street, between Mason and Taylor. The new wing will include 60 bedrooms, dining rooms, card rooms, library and accommodations for the club's juvenile membership and other needed improvements, which will cost approximately $300,000.

Calif., Sacramento—Articles of incorporation were recently filed by the Paramount Corporation of Sacramento, capitalization $1,000,000. The company plans erection of the Paramount Theater on K Street, between 9th and 10th.

Calif., San Jose—Offices—The Pacific Gas & Electric Company has purchased lots on South Third Street, near San Fernando Street, on which it is planning to erect a $100,000 building, three stories in height, to house all the local offices of the company.

Idaho, Pocatello—Store—Hotel—Plans are now being drawn for a $53,000 store and hotel building to be erected on East Center Street, by the George Cacavas Company, a well-known grocery establishment. H. A. Falkenberg of Montpelier, Idaho, is the architect. Construction work on the new building is expected to start in the near future.

Ore., Portland—School—Contract was awarded by the board of school directors recently for general work, U. S. Grant High gymnasium unit, to A. Pajunen at $115,000.

Ore., Marshfield—City Hall—The general contract for the erection of the new city hall was awarded to Graham & Aitken at $39,970.

Ore., Portland—Stores—Apartments—Two important building units consisting of stores and apartment house are to be erected at East 41st Street and Sandy Boulevard and Broadway at a cost of $150,000, according to a statement of Frank V. Healy, one of a group of Portland capitalists who are financing the project. It is planned to build the units distinct from each other with a court facing Broadway. The apartment house, Spanish style, will be 100 x 80 ft., of 3 stories and containing 25 apartments. The erection of this apartment house is on the cooperative basis and already several families have agreed to purchase apartments.

Ore., Portland—Bank—A 24-story tower together with a 3-story building addition are planned by the United States National Bank to occupy the 100 x 100-ft. lot on the N. E. corner of Broadway and Stark Streets, now occupied by the old Elks Building. Construction work is planned to start this fall when the present lease on the Elks Building will expire. It will be necessary to obtain special permission from the city council before erecting the tower as an ordinance prohibits the construction of office buildings more than 12 stories in height. A. E. Doyle in the Worcester Building is the architect.

Ore., Astoria—Offices—A business block costing between $200,000 and $250,000 is to be erected on 12th from Commercial to Duane Streets. The structure will be four stories high and 50 ft. deep. Fred L. Warren, C. R. Higgins, and Charles Niemi have completed the arrangements for this most extensive building project for Astoria since the fire.

Ore., Portland — Stores — A 2-story building costing between $75,000 and $100,000 is being planned by Houghtaling & Dougan for N. M. Unger, and is to be built on the south side of Alder Street between 6th and Broadway. The structure is to be Louis XIV style with figures in base relief along the upper wall. On the lower floor there will be three store rooms and on the upper floor five specialty shops may be fitted up with large windows facing Alder Street.

Ore., Portland—Apartments—A 4-story apartment house is to be erected at a cost of $100,000 by G. E. Heatham, 1170 East Davis Street. The location of the new building is 261 Eleventh Street and was planned by Claussen & Claussen, architects.

Utah, Brigham City—School—T. G. Rowland, of Logan, has been awarded contract for the erection of an addition to the Bear River Valley high school, located between the cities of Garland and Tremonton; price, $55,350.

Wash., Sedro Woolley—Lodge — Plans for a new Masonic Hall to cost $60,000, to be erected here, are being completed by Architect Andrew McQuaker, Mehlhorn Building, Seattle. Structure will be two stories high.

Wash., Sedro Woolley — Hospital — Plans for new unit at the Northern Hospital for Insane have been changed to provide for a home for nurses and attendants, instead of ward building, as planned. New home will cost about $85,000, and will provide for 120 nurses and attendants. Heath, Gove & Bell, Tacoma, architects, are preparing plans.

Wash., Seattle — Apartment — The Hawthorne Improvement Company plans the erection of a $200,000 group of apartment houses to cover an entire block in the Fremont district. Structure will be 2 stories with basement.

Wash., Seattle — School — Union High School District plans the erection immediately of an $85,000 high school structure, to contain a combination assembly hall and gymnasium, 12 classrooms, besides manual training and domestic science quarters.

Wash., Seattle—Court House — The Warrack Construction Company, here, recently received contract for construction of the proposed court house, jail and post office at Cordova, Alaska, to cost approximately $100,000.

Wash., Seattle—School—Wilson's Modern Business College will construct a new home, to cost about $85,000. Building will be 2 stories and basement, 120 x 108 ft., of mill construction.

Wash., Tacoma—School—Voters at city election recently authorized a $2,400,000 bond issue for the construction of new schools. Plans provide for six new intermediate schools, one large grade school and additions to seven grade schools.

Wash., Olympia—All bids for erection of main portion of the Legislative Building, part of the Capitol Group at Olympia, were rejected and new bids will be called on June 8. The lowest bid submitted was that of the Western Construction Company, Seattle, at $666,864. The building is to be erected to the main dome.